THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 32. Thursday, July 9, 1925. No. 464.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.

Foreign and Colonial, 17s. 6d. per annum.

All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL, BESSEMER HOUSE, 5, DUKE STREET, ADELPHI, LONDON, W.C.2.

Contents.

	PAGE
Safeguards of Foreign Contracts	25
Correspondence	26
Foundry Queries	26
A Core Compound Development	26
Experiments in the Manufacture of Chilled Iron Rolls	27
The Mechanical and Physical Properties of Cast Iron—Part I	31
Some Large Marine Valves—Part II	33
The Production of Castings—with Special Reference to Iron Castings	35
Mr. Allan John Grant	38
Personal	38
Feeding Ingots	39
The Testing of Cast Iron	40
Shrinkage During Casting	41
Manufacture of Magnesite	41
Trade Talk	42
Company News	42
Iron and Steel Markets	44

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1924-25, R. O. Patterson, Blaydon-on-Tyne.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.

Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.

Birmingham: H. James Roe, 33, Herbert Road, Bearwood, Birmingham.

Sheffield: R. Village, Albion Foundry, Whittington Moor, near Chesterfield.

Scottish: J. Bell, 60, St. Enoch Square, Glasgow.

London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

Newcastle-on-Tyne: Colin Gresty, 93, Queen's Road, Monkseaton, Northumberland.

East Midlands: H. Bunting, 17, Marcus Street, Derby

West Riding of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.

Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitechurch, Glam.

Welsh Engineers' and Founders' Association.

Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Safeguards in Foreign Contracts.

While anything in the nature of trade agreements is apt to meet with but scant consideration in periods of extreme depression, such as the basic industries of this country have experienced now for many months, the necessity for greater caution in our dealings with foreigners is becoming more apparent every day. The iron and steel industries, some sections perhaps more than others, seem particularly subject to such trying circumstances as the non-fulfilment of contracts, disputes as to quality, delivery, etc., refusal to arbitrate, and many other worrying difficulties, too numerous to mention, but all individually and collectively, potential matters for expensive law-suits in the future. This aspect of trade has probably been intensified since the war, as many individuals who became too unsettled to return to office, warehouse, or works, have blossomed out as merchants, many without either sufficient capital or the necessary technical knowledge successfully to carry on such an intricate business as the merchanting of iron and steel. While, of course, disputes must occur occasionally, even with the firms of the highest repute, yet it is the "small fry," with its boldly-designed paper head, that is the most prolific source of trouble in this respect.

Complaints of the character mentioned are frequently received by the Committee of Management of the London Iron and Steel Exchange, particularly in regard to contracts placed with Continental suppliers of iron and steel materials, and measures of a precautionary character have had to be taken to combat this ever-growing evil. It is unnecessary to point out that we are aware of the high reputation enjoyed by many Continental suppliers, and what safeguarding measures are adopted are as much in the interests of these firms as of the traders in Great Britain. In future the members of the Exchange are invited to communicate any complaint to the Secretary, although the Committee does not propose to express any opinion upon the transaction. It will, however, record the names of the parties concerned, so that when requests for information are received the Secretary will be in the position to supply the names of British firms who have already experienced trouble with the foreign concern specified in the complaint. Whilst this scheme will absolve the Exchange Committee from all responsibility, it will also foster a spirit of friendliness and goodwill among the British traders themselves, and may save large sums of money in useless lawsuits.

We have a recent case in mind in which some such scheme would have been most beneficial. In this instance several thousand tons of heavy steel scrap were offered from the Continent, the purchasers sending their representative to inspect what proved to be a stack of best heavy shipyard. On its arrival at a British port, however, it was found that a large proportion of light steel scrap had been substituted, the value being substantially less than the material inspected. Subsequent investigations proved the sellers to have acted merely as agents, and the inadvisability of wasting further money on legal proceedings.

Now that our import trade has assumed such large dimensions, the scheme adopted by the London Iron and Steel Exchange will prove most useful, as it will provide some safeguards in dealing with foreign firms of whom the industry has no knowledge, and as a medium for extracting information regarding Continental concerns offers means whereby traders can be assured, as far as possible of dealing with reputable suppliers. If it is responsible for the elimination of only a few doubtful firms from the industry it will have served a most useful purpose. There is an un-

official black list in existence in London in regard to British firms, and it is about time that some such list were instituted to cover foreign concerns.

An additional safeguard is suggested by the Management Committee of the Exchange in the form of an arbitration clause for insertion in contracts and conditions of sale. This provides for the construction and performance of the contract to be governed by English law, and all disputes arising to be submitted to an arbitrator selected by the Committee. We recommend the adoption of similar arrangements by other Exchange Committees who have the interests of their members, and incidentally the cleansing of the industry, at heart.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

The Venting of Moulding Sands.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In the report of the discussion which took place on Prof. Ries' Paper, the effect of words used by Mr. Young, which I quoted, is, as printed, put into my own mouth. Mr. Young in effect stated, further to what you print, that he had seen close sands and open sands rammed up into moulds, that castings equally good came out in each case, and that the question of permeability did not matter in practice. I pointed out that a very important part of the art which the apprentice moulder has to acquire is that of venting; or, in other words, the giving of a permeability to the sand which is additional to that naturally present; so that gases, generated and expanded at the mould face, during and immediately after contact with the molten metal, may pass easily away, instead of boiling up through the liquid casting—as they otherwise would do. This is equally true of a mould as of a core, though in less degree of a dry-sand than a green-sand mould—differing with the character of the job. I pointed out that these gases can be seen burning on reaching the outside air, and that whilst casting is proceeding. It was at this point that Mr. Young interjected that permeability has nothing to do with this. Now, I should like Mr. Young to answer the question which I put to him then, *i.e.*, if the gases which are burning outside the mould are not gases which are generated or ejected from the mould face and its immediate backing, what are they? Further, if the sand were not permeable, how would they pass away from the mould face, except through the molten metal? The degree of permeability is also the degree of easy venting properties of a sand, which is an important measure of the value of a sand for the making of castings.

I once heard Mr. Young remark that the moulder, as a chemist, is a good moulder. It occurs to me that the chemist, as a moulder, is a good chemist. If Mr. Young had served an apprenticeship to moulding he would have in his recollection (like every other moulder) details of numerous scrap castings which he had made, due to the use of insufficiently permeable sand, or to the failure to add to that permeability by the judicious use of the vent wire, or other opening agent.—Yours, etc.,

J. LONGDEN.

11, Drumry Road, Clydebank.

Perlit Iron.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—In connection with Mr. Young's Paper on the Lanz process of making pearlitic cast iron I would like to ask:—

(1) What moulder could core up a complicated mould at a temperature of 200 or even 100 deg. C.?

(2) What moulder would risk transferring a mould—say, a Diesel cylinder head mould—after coring up at ordinary temperature to the stove to be heated up to 200 deg. C. and then withdraw and cast?

(3) How many members are aware that a pig-iron has been produced since 1920 with a composition specially designed for making pearlitic iron at a low cost not 100 miles from Glasgow?

(4) At Cardiff, when reading my Paper on High Tensile Cast Irons I showed samples of 3 in. dia. all pearlitic, and also under the microscope two samples taken from large pieces of pearlitic cast iron.—Yours, etc.,

A. MARKS.

Dudley.

A Correction.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I should like to call attention to an omission in the printing of my discussion on Mr. Young's Paper in your last issue, page 8. In paragraph 3, line 3 the word "white" has been omitted and the whole sentence should read:—(1) The fundamental feature that the cast iron must be *white* when cast normally, etc.—Yours, etc.,

J. E. HURST.

Centrifugal Castings, Limited,
Kirkstyle Road,
Kilmarnock.

Foundry Queries.

Power for Shot Blast (July 2).

Primarily the writer would like to know why "A.B.C." finds it necessary to use shot blast. It has been proved in modern practice that all castings, either ferrous or non-ferrous, can be more effectively and economically cleaned by the use of sand than by shot blast.

It is obvious the consumption of 36 units per hour is because shot blast always increases the number of electric units consumed per hour on account of its greater weight compared with sand, which means greater propelling power required and always greater wear and tear to the machinery. The following factors should be borne in mind:—(1) Moisture is always present where air is compressed; (2) steel abrasives must rust in the presence of moisture; (3) steel shot gives a slimy finish to the castings; and (4) sand gives a sharp finish to all metals.

If "A.B.C." would consider the possibility of using sand blast plant, the writer would be quite willing to offer his views drawn from practical experience.

X. Y. Z.

Metal Suitable for Withstanding Red Heat (July 2).

"C.N." for such small articles as pyrometer sleeves would be well advised to use one of the well known nickel-chromium alloys, which are manufactured in London, Birmingham and Sheffield. For furnace castings, a study of the report of the recent symposium on Diesel engine castings, held in Glasgow, will reveal the essentials to be observed in the production of iron castings with a minimum of growth.—ED.

A Core Compound Development.

Of interest to British Foundrymen is the announcement that a new company, The Binders International Company, Limited, of 56, Moseley Street, Manchester, has been formed to take over the sole selling rights of the well known "Bindo" core binding materials of the Avebene Company.

"Bindo" is a material of international reputation, and is equally well known and appreciated in the iron, steel, brass and aluminium foundries of Holland, Belgium, France, Spain and Italy. Free samples and demonstrations are available to foundries on application.

MR. WESLEY LAMBERT, chief metallurgist to Messrs. J. Stone & Company, Limited, is expected home next Monday after an extensive business tour in South Africa.

MR. E. J. RANG, students' secretary of the Newcastle Association of the Institution of Civil Engineers, and immediate past-president of the Institution of British Foundrymen, Newcastle-upon-Tyne, Junior Section, has gained the degree of M.Sc. in Civil Engineering in Durham University.

Experiments in the Manufacture of Chilled Iron Rolls.

By Archibald Allison, Sheffield.

(*Continued from page* 483.)

Casting Temperature.

In all the experiments recorded here, the temperature of tapping the roll metal and the casting temperature of every cast were observed with an optical pyrometer of the disappearing filament type. The first metal flowing from the cupola has naturally cooled somewhat, the last melted being considerably hotter. Since two or three taps were usually made to get a ladleful of the metal, it was possible to note the variations and obtain an average figure.

It was found that "cool" metal was about 1,340 deg. C., the "hot" metal 1,400 deg. and over, the temperature for normal working being about 1,370 deg. C. Be it noted that the experienced eye of the foundryman can detect this difference of 60 deg. between 1,340 and 1,400 deg.

This is of high importance in chill-roll casting, since no time must be lost in cooling and examining the trial test piece, if the heat of tapping is 1,360 deg. or less.

Molten iron in a 25-cwt. ladle cools very rapidly. With a ladle of three taps giving 1,360, 1,370 and 1,400 deg. C., the average for the ladle will be about 1,360 deg. The metal now has to wait until the test piece is taken, a matter of 8 to 10 minutes. If the metal is correct in chill, the ladle is tilted for skimming the slag off, preparatory to casting. Temperatures taken at this stage generally show a drop of about 130 deg.; that is to say, if the tapping heat was 1,370 deg., the ladle heat after skimming would be 1,240 deg. After the further two or three minutes required to get the ladle to the moulds for casting, it was found that the temperature of the stream pouring into the trumpet runner was 1,220 deg. C. There is the question as to the accuracy of the readings taken on the surface of the clean, though still, metal in the ladle compared with readings on the stream of flowing metal, but it was generally found that the three important points—tapping temperature, ladle temperature and casting temperature—were quite consistent in sequence. If the metal came from the cupola at 1,350 deg. or less, there was no time to lose at any stage.

Of course, if the grey iron for letting down the chill was ready and hot, there would be a gain of heat if an addition of metal was required. Generally it was found desirable to be able to cast at a temperature not less than 1,210 deg., and to obtain this minimum a tapping temperature of 1,360 deg. is necessary. The effect of casting below this is found to be uncertainty as to defects in the rolls. In the casting trumpet there are small bleed holes allowing the metal to trickle past the stopper, so that the wobbler and neck at the base are filled with metal before the flush of metal filling the barrel. With cold metal small shot are formed which do not re-melt, but form defects in the barrel. Other defects are gas cavities. Altogether the minimum temperature appears to be 1,200 deg. C.

As to a maximum, the routine of the process generally prevents an excessive heat, but in any case it is undesirable to have very hot metal, since the graduation from the chill portion to grey centre would be too sudden, forming a line of weakness, and in hot mill rolls the chill is liable to lift away from the core under such conditions. Also in all metals cast too hot there is the liability to gas cavities. It was found that with rolls cast hotter than 1,250 deg. C., gas cavities more or less filled with segregate occurred at the ends of the rolls, together with pin holes on the barrel. These may be removed in turning, but obviously entail a waste of material.

FIG. 1. FIG. 2.

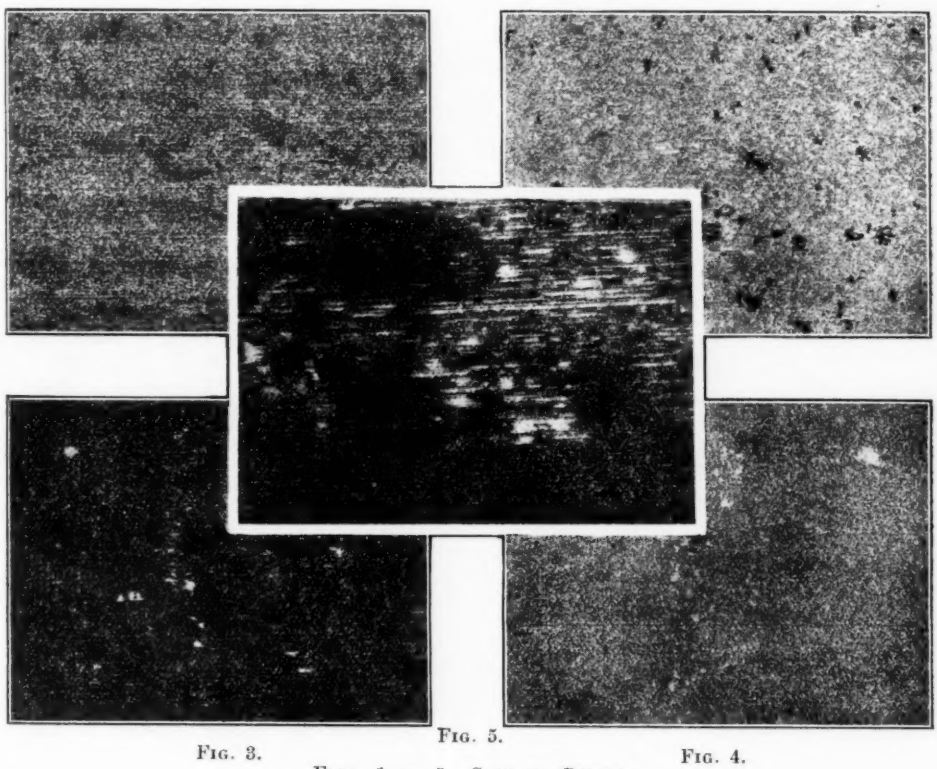


FIG. 3. FIG. 5. FIG. 4.

FIGS. 1 TO 5.—SULPHUR PRINTS.

Casting Details.

The usual method of casting chill rolls is by ascension casting, employing a trumpet runner with a very large trumpet top. This stands 2 ft. above the top of the mould, and the mouth of the runner is fitted with a stopper, except that two holes are left at the side as by-pass. In casting, the molten metal is poured rapidly to fill the trumpet, small streams flow past the stopper through the small holes to fill the bottom wobbler. When the trumpet is full the stopper is removed, causing a rapid flow of metal which enters the mould on the neck of the roll tangentially. The head of liquid metal thus produces a rapid circular motion, so that the barrel portion of the roll is not only cast rapidly but with a smooth surface and good skin, any slag or dirt being driven to the centre and washed away. Sufficient metal is always used to give a good overflow from the open top of the mould.

As to the chill part of the mould, it would not appear necessary to have a great thickness from heat considerations, since the chilling effect is rapidly complete in the relatively thin skin required. Since, however, it is desired to produce an object as true and circular as possible and free from distortion, it is necessary to have the chill mould of massive dimensions. Therefore, it is the general rule that the thickness of the chill should be half the diameter of the roll.

ROLL A.

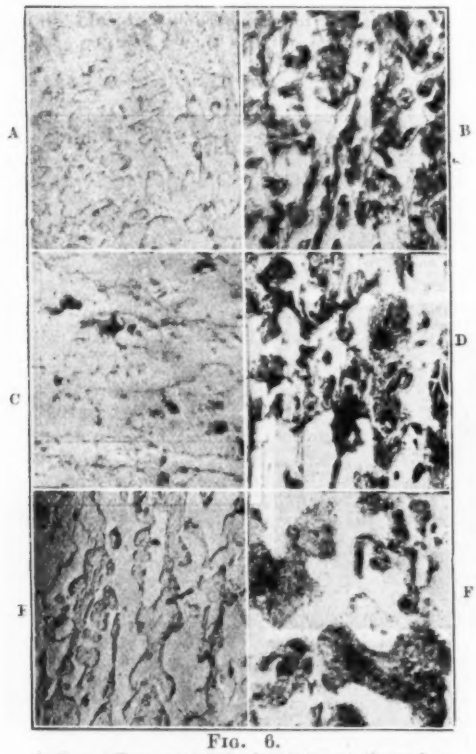


FIG. 6.

A, C, and E are unetched micro taken at the surface, ½ in. and 1 in. from the surface, whilst B, D and F are similar but etched. All are at x 100 dias.

Analysis and Chill.

In order to draw up some rule as to how far analysis governs depth of chill, averages were taken, with the following results:—

	Si.	Mn.
1¼ in. chill, average 18 casts	0.62	0.33
1½ in. chill ,, 9 ,, ...	0.67	0.34
1 15/16 in. chill ,, 3 ,, ...	0.71	0.38
Odd cases*		
⅞ in. chill*	0.76	0.43
	0.90	0.40
¾ in. chill*	0.90	0.53
	0.84	0.51
	0.76	0.71
	0.74	0.38
	0.76	0.43
	0.98	0.34

* By melting together chills of 1 13/16 to 1 15/16, the average of 43 cases is 0.67 per cent. Si. and 0.34 per cent. Mn.

In this connection there are many discrepancies met with, but these are eliminated by taking results in bulk and on average. Thus it was found that among the 1¼-in. chill iron there was one analysis 0.80 Si and 0.39 Mn per cent. which was much too high. The roll in the lathe, however, had only ⅞-in. chill in the rough. From this and other cases the deduction is drawn that the test-piece method is only approximate. In fact, the roll-turner's opinion is only approximate, since rolls broken in service frequently reveal widely different chill at the fractured middle than at the ends. This is natural because of the change in the mould from composition to chill at those points.

TABLE VI.—*Analyses quoted by Dr Schüz*.*

	C.	Si.	Mn.	P.	S.
German strip rolls	3.82	0.74	1.34	0.44	—
	3.10	0.45	0.55	—	—
	3.42	0.53	0.46	0.53	0.13
	3.50	0.54	0.47	—	—
	3.00	0.71	0.39	0.54	0.098
American origin	3.45	0.72	0.30	0.58	0.02
	3.85	0.69	0.25	0.50	0.08
	3.50	0.65	0.35	0.45	0.08
English origin:					
Strip rolls ..	2.79	0.74	0.42	0.58	0.13
Chill thin, but good	3.48	0.68	0.29	0.41	—
Ideal roll (Nicholson)	3.50	0.65	0.50	0.25	0.05
Belgian origin ..	3.02	0.72	0.55	0.473	0.134
Very good ..	2.90	0.66	0.81	0.340	0.096
Swedish origin	3.50	—	1.00	0.05	—

ROLL A.

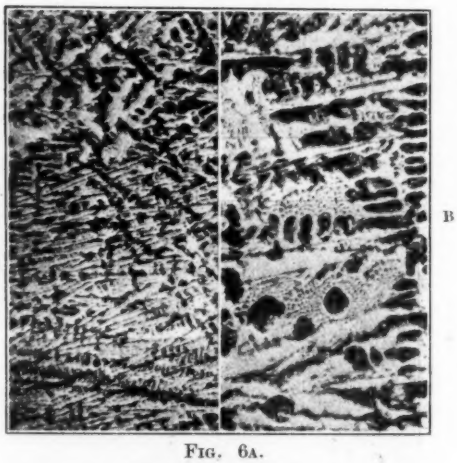


FIG. 6A.

"A" near surface x 100.
"B" ½ in. from surface x 100.

TABLE VII.—*Analyses given by Dr. Schüz.*

Depth of chill in inches.	C.	Si.	Mn.	P.	S.
1¼ in. average ..	3.30	0.61	0.54	0.66	0.11
1⅛ in. ,, ..	3.32	0.60	0.52	0.60	0.116
1 in. ,, ..	2.82	0.66	0.44	0.67	0.107
13/16 in. ,, ..	3.08	0.68	0.47	0.62	0.109
⅞ in. ,, ..	3.12	0.70	0.41	0.60	0.080
9/16 in. ,, ..	2.87	0.78	0.55	0.48	0.102
5/16 in. ,, ..	3.15	0.75	0.47	0.50	0.101
⅜ in. ,, ..	3.00	0.77	0.53	0.50	0.116
5/16 in. ,, ..	2.81	0.71	0.42	0.60	0.103
7/16 in. ,, ..	3.81	0.80	0.46	0.57	0.100
¼ in. ,, ..	2.95	0.77	0.62	0.54	0.106
5/16 in. ,, ..	2.82	0.79	0.57	0.50	0.096
⅛ in. ,, ..	2.58	0.85	0.67	0.54	0.102
¾ in.† ,, ..	3.34	0.60	0.61	0.46	0.05
¾ in.† ,, ..	3.38	0.80	0.76	0.50	0.06
†	—	1.07	0.40	0.44	0.21
⅛ in.† ,, ..	3.16	1.00	0.42	0.64	0.19
Kirk. ,, ..	2.18	0.78	0.21	0.50	0.061

* Stahl und Eisen, 1923.
† Quoted by McWilliam and Longmuir.

Working under similar conditions, the conclusion was arrived at that analysis is a more reliable guide to depth of chill than the usual test piece of 1 or 1¼ in. thickness.

The exact amount of chill obtained is a resultant of the possible chemical affinities in a quinquenary

or sextenary alloy, that is, iron, carbon, silicon, manganese, phosphorus, and possibly sulphur, over a temperature range of 180 deg.

In the precipitation of graphite in cooling from 1,000 to 950 deg., silicon and phosphorus to some extent tend to displace the carbon from combination, whilst manganese, at all events when present to the amount of 0.8 per cent., tends to retain the carbon in combination. The principal effect is the depth of chill resulting from opposed forces, of the chill to retain carbon in combination, and of the elements whose affinities expel the carbon from combination; but before this, there are the chemical and physical actions in the metal in the range between solidification and the actual precipitation of graphite.

ROLL A.

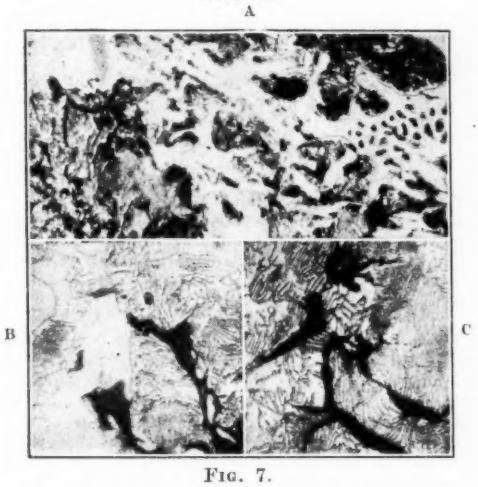


FIG. 7.

A is taken 1 in. from the surface x 100; B near the surface x 500, and C 1 in. from the surface x 500 dias.

ROLL B.

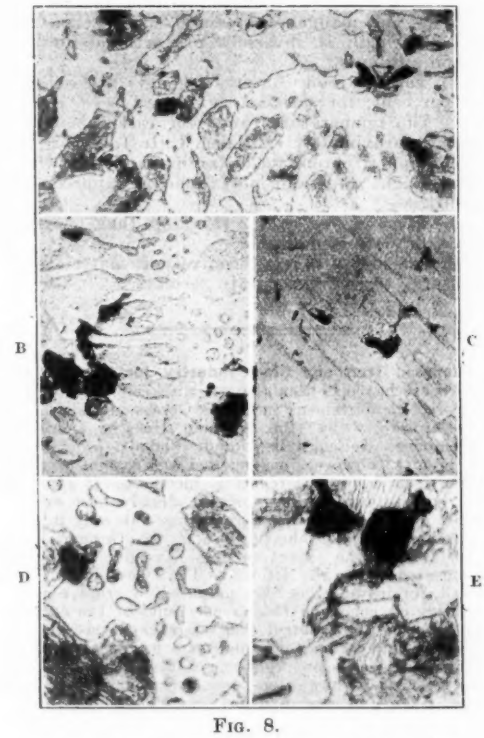


FIG. 8.

A, B, C and D are taken from near the surface, whilst E is from a depth of ¾ ins.
A, B, D and E are etched; C is not.
A, B and C are at 300 and D and E at 500 dias.

Service Conditions.

It is naturally the roll turner who has to pass the rolls as suitable or otherwise for service The points held in view are general soundness of casting, the thickness of chill, quality of the chill as regards freedom from specks, pinholes, or soft spots. "Dark mottle" and pinholes are the most frequent causes for anxiety.

Sulphur prints taken on such areas frequently reveal no segregation, although in the neighbourhood of a small pinhole sometimes there is an area richer in sulphur. The sulphur prints Figs. 3 and 5 show such areas. The white parts are tool marks except two small round spots where the pinholes were. Fig. 1 was taken from a roll exhibiting "dark mottle," and Fig. 2 was taken when the skin was only just removed, and by comparison with Fig. 1 would seem to indicate that the metal has picked up sulphur from the blacking employed to coat the chill mould. Fig. 4 is from a normal roll with moderate sulphur.

ROLL B.

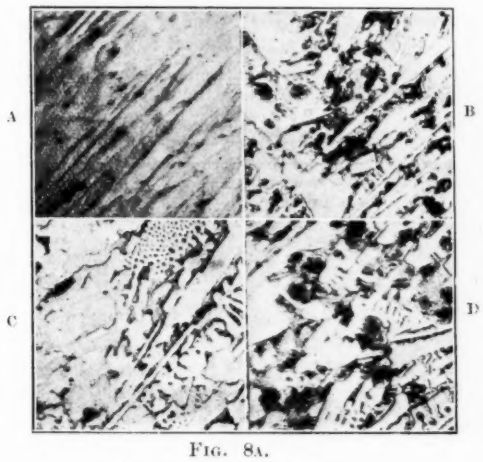


FIG. 8A.

A. Near surface, unetched x 100.
B. As A, but etched x 100.
C. ¾ ins. from surface, unetched x 100.
D as C, but etched x 100.

When the chill mould has been used for a large number of casts, the surface becomes to some extent rough and oxidised. In the absence of all other factors, the conclusion is arrived at that the condition of the chill surface, together with the thickness and adherence of the blacking to the surface, has an important effect on the appearance and quality of the roll surface.

In chilled iron rolls used for hot rolling, the service demanded is very severe. The extremely brittle material is subjected both to shocks and temperature changes. The relatively large diameter of the roll enable it to withstand the shocks of pieces entering and leaving. The temperature conditions to some extent are met by the mass, but it is noteworthy that roll breakages often occur when starting on Monday mornings, or after a stoppage, particularly in frosty weather.

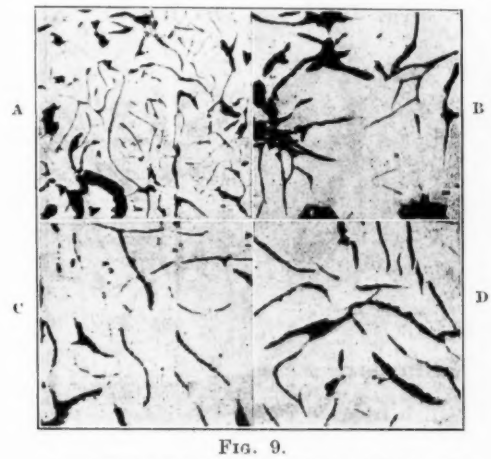


FIG. 9.

A and B, Swedish Cold Blast Pig, unetched, x 100.
C and D, same material unetched, x 100.

It is a matter of importance to change the hole or strip of roll actually used, by moving the guides, to prevent overheating in one place and consequent fracture. Also to give a good surface to the product it is necessary to maintain a good surface on the rolls, and this can only be done by frequent dressing. Therefore, the life of chill rolls is not long in hot rolling, because of the dressing and grinding and the casualties of service, heat conditions, etc.

Microscopy.

Microscopic examination reveals some familiar features. The dendritic structure is naturally

ROLL C.

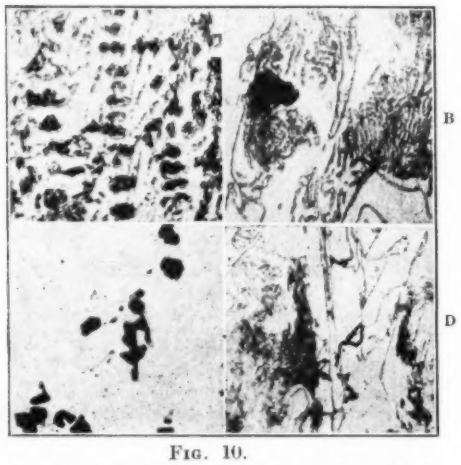


FIG. 10.

A, near surface, etched x 100. B, near surface, etched x 500. C, near surface, unetched x 300. D, etched x 300.

finer near the surface. Roll A (Fig. 6), in the print near the surface, etched, exhibits a rosette of graphite, showing that the chill was almost worn through before the roll broke. In all these irons the graphite is precipitated in rosettes or circular patches, giving the familiar appearance seen on the roll necks in machining.

The second print of Roll A, Fig. 7, taken about 1 in. from the surface, shows a larger rosette of graphite, and in a similar field of 500 dia. shows

ROLL C.

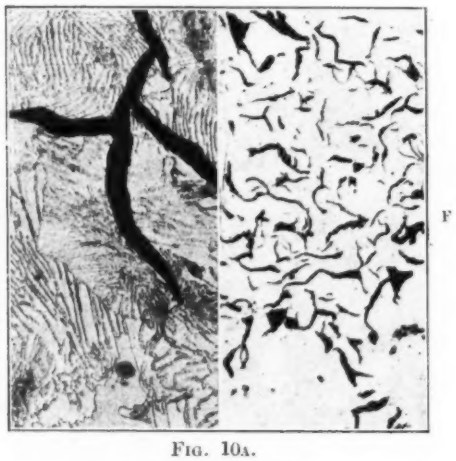


FIG. 10A.

E, grain etched x 500.
F, grain unetched x 100.

well laminated pearlite with some sulphide spots. Near the surface at 500 dia., the small rosette referred to above is seen to have sulphide spots associated with it, and others are in the same field. The chill test piece gives the finer structure proportional to its mass.

Roll B (Fig. 8) broke in service before being much worn, and shows a correspondingly finer structure. At higher magnifications it will be seen that the sulphide spots have characteristic shapes and arrangements. Many of the spots are either triangular or rhombic, or compounded of these two shapes.

The prints at 300 dia. show their arrangement, and the photographs at 500 dia. their characteristic shapes. In view of these clusters of sulphide spots, though only small, the conclusion must be drawn that high sulphur should be avoided in rolls for hot rolling. In spite of the fact, too, that rolls with sulphur 0.17, phosphorus 0.60, and sulphur 0.166 and phosphorus 0.510 per cent. have given satisfactory service.

In view of a suggestion that re-melting cold-blast iron causes a finer precipitation of graphite, the prints shown in Fig. 9 were made.* The photo-micrographs of Swedish cold-blast iron were taken from a small piece having both open and close fracture, such as is quite usual; actually the fields photographed were about half-an-inch apart. Pieces from two separate melts made in the cupola indicate negligible differences as far as graphite is concerned. The rosette formation is noticeable. The thicker flakes and dark patches are obviously due to being cut at an angle.

A roll which broke after a short service is represented in Fig. 10. In this case the failure was attributed to the depth of chill being too great; but here again, from the print near the surface unetched x300, it is difficult to avoid the conclusion that the sulphur contents (0.18 per cent.) contributed largely to the breakage. In the grain part of the roll, too, the graphite is arranged only partly in rosettes and partly in semi-dendritic figures.

In the grain part, examined at 500 dia., the graphite is contained in a matrix of well-laminated pearlite, and the sulphide spots, as may be expected, rounded somewhat instead of being sharply angular.

Conclusions.

(*a*) Silicon is the dominating factor in determining the amount of chill.

(*b*) A manganese contents in excess of 0.36 per cent. seriously affects the depth of chill.

(*c*) With moderately low sulphur and phosphorus contents and manganese under 0.36 per cent., the depth of chill is inversely proportional to the silicon contents.

(*d*) Total carbon contents should not exceed 3.3 per cent. for satisfactory service.

(*e*) The temperature range for casting is very small, approximately 1,210 deg. C. to 1,250 deg. C.

(*f*) Copper, chromium, titanium and vanadium were sought for, and not found in appreciable quantities.

(*g*) There is reason for thinking that low sulphur contents is desirable.

(*h*) The most careful control of materials is necessary to secure accurate results.

Proposed Iron and Steel Industry for Brazil.—An old report has just been revived with reference to the proposed establishment in Minas Geraes, Brazil, of a large ironworks by the German Hoesch, Deutsch-Luxemburg, Gelsenkirchen and Phœnix companies. An inquiry, however, has elicited the statement that in the form given the report is incorrect. It appears that some of the concerns named already own extensive iron-ore areas in Brazil, and they naturally intend to utilise them for the purpose of the German iron industry, but the export of ores is rendered difficult owing to some restrictions. The Government of Brazil, for instance, is only prepared to grant export facilities on condition that 5 per cent. of the output is smelted in the country. On reference to past issues it will be found that for some years past the problem of finding means for producing a certain amount of iron in Brazil has been under consideration, but very little has happened so far. Should such a scheme be initiated the German interests would be unable to finance the construction of the necessary works, owing to present unfavourable financial conditions. At the most they could only offer expert advice and undertake the technical management of the venture, while the capital would have to be provided by the State and private undertakings in Brazil. Under these circumstances the realisation of the scheme would represent an essentially Brazilian and not a German undertaking. For the rest the matter is said to be not yet ripe for further discussion.

---

* W. E. Jominy, "The Iron and Coal Trades Review," December 5, 1924.

The Mechanical and Physical Properties of Cast Iron. – Part I.

By J. E. Hurst.

(*Continued from page* 548.)

Casting in Permanent Metal Moulds or Chills.

The practice of casting in metal moulds is accompanied by a considerable increase in the rate of cooling, and cast iron cast in this manner invariably shows an extremely close-grained fracture. It has been definitely established that casting in metal moulds is accompanied by a considerable increase in the ultimate strength value over and above that of the same material cast in sand.

The experiments of Broughall are of considerable value in this connection, and clearly show the increase in strength as a result of casting in metal moulds. These experiments also show the effect of annealing such castings from permanent moulds and the immense improvement of the ultimate strength values as a result of this treatment. The results are given in Table I.

TABLE I.—*Strength of Sand Cast and Permanent Mould Cast Test Bars (Broughall).*

Sample.	Total C.	CC.	Gr.	Si.	Mn.	S.	P.	Transverse. Load.	Transverse. Def.	Tensile Tons per sq. in.	Brinell.
Sand cast	3.27	0.34	2.93	2.84	0.51	0.068	1.07	23⅝	0.14	11.30	170
Sand cast annealed	3.27	0.19	3.08	2.77	0.50	0.077	1.07	24	0.14	10.96	149
Permanent mould cast ..	3.27	0.63	2.64	2.77	0.49	0.081	1.06	27⅛	0.10	15.22	269
Permanent mould cast annealed	3.30	0.11	3.19	2.77	0.52	0.071	1.10	34½	0.15	17.40	217

Piston Ring Drum Tests.

One of the difficulties in testing castings which are systematically produced in metal moulds is the obvious one that unless the test-bar is cast under identical conditions it cannot possibly give any indication as to the strength of the actual castings. In such castings as piston ring drums this condition has been conveniently met in the recent British engineering standards specification. In this specification the ultimate strength test is performed on an actual ring cut from the casting. This ring, after splitting, is pulled apart by a load applied at the opposite ends of the diameter which is at right angles to that of the gap. The specification requires that such a ring must withstand a stress of at least 16 tons per sq. in., calculated from the following formula:—

$$S = \frac{P.d.}{1{,}200\ bt^2}.$$

Where S = stress in tons per sq. in.; P = load in pounds; d = external diameter of closed ring in inches; b = width of ring in inches; and t = radial thickness of ring in inches.

This formula is of the same type as the well-known bending formula, and is designed to convert the loads applied to curved beams of this type into direct ultimate strength. For rings of small radial thickness where the variation in position of the neutral axis is almost negligible, as in small piston rings, this gives very satisfactory results.

Elasticity Test.

A comparative knowledge of the elastic properties is of primary importance in forming an opinion of the value of cast iron for piston ring purposes. In the above-mentioned test the elastic modulus can be determined by the measurement of the change in width of the gap in the ring with increasing load. Under the conditions of the test the elastic modulus E can be determined from the formula:—

$$E_n = \frac{5{\cdot}37\left(\frac{d}{t} - 1\right)^3 Ql}{by_1}$$

Where y_1 is the change in gap.

The specification requires that the change in gap shall correspond to a limiting value of E of 14,000,000 lbs. per sq. in.

Torsional Strength of Cast Iron.

Cast iron is rarely designedly called upon to withstand torsional stresses, and for this reason there is little information available on the torsional strength of cast iron. In the exhaustive experiments of Fairbairn made about the year 1860 on the strength properties of cast iron a series of torsion tests were included. It is unfortunate that in all these experiments no chemical analyses of the materials used were recorded. The results of these torsion tests are recorded in the Table II.

In these tests the distance between the keys which secured the ends of the bars when strained was 15 in. The length of the part of the bar subject to the torsion was about 8 diameters. It appeared that the force requisite to give the bar a permanent set of ½ deg. is about 9-10ths of that which will break it.

TABLE II.—*Torsion Tests on Cast Iron.*

Description of metal.	Fusion.	Diam.	Angles of Permanent Set at 1,000 lbs.	1,500 lbs.	2,000 lbs.	2,500 lbs.	Maxima.	Breaking weight.	Torsional strength $\frac{S = Wr}{d^3}$ Ultimate	At set of ½°.	Ratio.
No. 1 Cast iron	2d	1.916	0°.2	2°.2	—	—	12°.9	1,737	6,176	4,442	0.724
,, ,,	3d	1.875	0°.0	0.3	3°.8	—	16.0	2,320	8,799	6,447	0.733
No. 1 and 3 Cast iron	2d	1.913	0°.0	0.1	0.7	2°.4	10.5	2,730	9,752	6,611	0.678
	3d	—	—	—	—	—	—	—	—	—	—
Nos. 1 and 2 Cast iron	2d	1.927	0°.1	0.9	—	—	21.7	2,245	7,847	4,723	0.601
	3d	1.893	0°.0	0.0	0.8	4.9	16.7	2,840	10,467	7,000	0.669
Nos. 1, 2 and 3 Cast iron	2d	1.908	0°.0	0.1	1.0	3.9	14.0	2,697	9,711	6,793	0.700
	3d	1.908	0°.1	0.2	0.5	2.5	6.9	2,515	9,065	7,130	0.786

Hardness Tests.

In many ways the application of the hardness tests to cast iron have developed in a different manner from their application to most of the other commercial metals and alloys. In the case of steel and non-ferrous alloys the relation between the hardness value as determined by methods of the Brinell type and the physical condition of the alloys has been fairly well established, with a result that the simple determination of this value during the various operations to which these alloys are subjected in the course of manufacture indicates within sufficiently close limits the physical condition of the alloy, and hence gives some indication as to whether its ultimate strength properties, and possibly other properties, are within the desired limits.

The extreme simplicity of the application of

hardness tests and the fact that they can be readily applied to actual articles, thus rendering unnecessary separate test-bars, has appealed to both engineers and metallurgists as a means of testing materials with a view to ensuring their conformity with standard requirements.

In the application of hardness tests to cast iron one of at least three objects are desired, according to the particular requirements of the castings under consideration, viz:—(1) To ascertain the machining qualities; (2) to ascertain the wearing qualities; and (3) as a general simple test to ensure uniformity and compliance with other standards.

In connection with these considerations various forms of test have been proposed, such as Turner's sclerometer or scratch hardness test, and the "drill test" designed by Weep. This latter is particularly useful in determining the machining qualities. The principal difficulty, apart from any difficulties of a manipulative nature, in the application of such tests is the lack of an easy method of quantitatively expressing the results.

The Brinell Test.

This is an indentation test, and, as generally practised, consists of the indenting of the specimen with a hardened steel ball of known diameter under a constant load. A comparison of the hardness values is made by comparing the diameter of the impressions made on the samples. This test has been the subject of considerable investigation during recent years, and various modifications both in the method of carrying out the test, expressing the results and the shape of the instrument making the impression have been proposed. The significance of these various modifications as applied to cast iron have not yet been fully investigated.

The Shore Scleroscope.

A comparison of the height of rebound of a small diamond-pointed hammer falling on to the specimen from a constant height is used as a measure of the hardness value.

Both these tests are the ones most frequently used in connection with cast iron, and from the point of view of uniformity of the results and the manner in which they vary with the other physical properties there is not much to choose between them. There is a tendency recently to prefer the Brinell test carried out, using a 1 mm. dia. ball in preference to the standard 10 mm. ball usually applied. From a series of comparative tests Prof. Turner concludes that as a rough approximation a multiplying factor of 6 can be used for the conversion of scleroscope hardness figures to Brinell hardness figures. Attempts to convert these two figures are not to be recommended, and the above factor should only be used as a guide for making mental comparisons.

Relation between Hardness and Ultimate Strength Properties of Cast Iron.

The ease and simplicity of the hardness test has been responsible for the many attempts which have been made to determine the relationship which might exist between the ultimate strength and hardness properties of cast iron. F. J. Cook* constructed a series of curves embodying the results of many hardness tests conducted by the drill method and showing the distinct relationship which existed between these results and the transverse and tensile tests.

During recent years Portevin† and Schuz‡ have investigated this relationship further. Portevin concludes that it is possible to construct formulæ of an empirical nature for the conversion of ball hardness tests into tensile and compressive strengths. Schuz shows that the tensile strength of cast iron falls as the ball hardness diminishes and the relationship follows a straight line law which can be expressed by the formula:—

$$Kz = C \frac{H - 40}{6} \text{ Kg mm}^2.$$

Where Kz = tensile strength in Kg mm² and H = ball hardness.

Schuz also finds that the relationship between the ball hardness and the combined carbon follows a straight line law.

* J. Staff, I.S.I., 1910.
† Revue Universelle des Mines, March, 1922.
‡ Stahl und Eisen, Vol. 43, pp. 720-723, May, 1923.

These considerations can only be considered to hold in cast iron cast under comparative conditions. It is quite easy to show that with wide variations in the cooling conditions of samples of the same composition a considerable difference in the hardness value is always present. Taking an extreme case as an example and comparing the results of a chill-cast and sand-cast annealed samples of cast iron as given in the table below, we find that the chill-cast annealed sample, in spite of having the same general composition, the combined carbon is higher in the sand-cast than the chill-cast sample, yet in spite of this lower combined carbon value the Brinell hardness value is considerably higher in the chill-cast sample.

Condition.	Ce.	Gr.	Si.	Mn.	S.	P.	Tensile.	Tansv.	Brinell.
								Cwts.	Cwts.
—	0.191	3.08	2.77	0.55	0.077	1.06	10.96	24	149
—	0.110	3.19	2.77	0.52	0.071	1.10	17.40	34.5	217

It is legitimate to conclude, and experiments bear out the fact, that with intermediate stages of rate of cooling between extremes of such a nature the hardness value varies in this manner.

Hailstone* shows very clearly that the diameter of the indentation made in the scleroscope hardness test varies with both the casting temperature and the specific gravity of the samples. These results have not been given the attention they deserve, and have often been overlooked. Up to a casting temperature of 1,400 deg. C. the variation in hardness bears almost a linear relationship with the specific gravity. At a temperature of 1,400 deg. C. something of the nature of a critical point is evident. A careful reinvestigation of these figures on these lines would be a welcome addition to our knowledge, but the figures serve to show that independently of the composition the hardness value varies with the specific gravity. This is probably the same thing as saying that the hardness varies with the closeness of grain which would appear reasonable to most foundrymen.

We may therefore only expect the hardness value to vary regularly with the chemical composition of cast iron when all the other conditions of rate of cooling and casting temperature have been maintained constant.

It likewise follows that those constituents which influence the condition of the carbon will influence the hardness value in accordance with the direction in which they influence the presence or absence of carbon. Sulphur in the condition influencing the retention of the combined carbon will increase the hardness figure. Conversely, silicon will tend to decrease the hardness figure.

Manganese, owing to its tendency to promote the formation of graphite when in the presence of silicon and also owing to its influence in balancing the influence of the sulphur, will likewise tend to lower the hardness value.

Phosphorus, on account of its intrinsic hardness when existing as the phosphide eutectic, which has a hardness of 5 on Mohr's scale (according to Stead), has the tendency to increase the hardness of cast iron as a whole.

It is a general law that the hardness of solid solutions of more than one metal gradually increases with increasing concentration of the metal in solution, and the hardness values plotted against the concentration values lie on a smooth curve. Any break or inflexion in such curves indicates a molecular change in the solution, either the formation of a chemical compound or some new series of solutions.

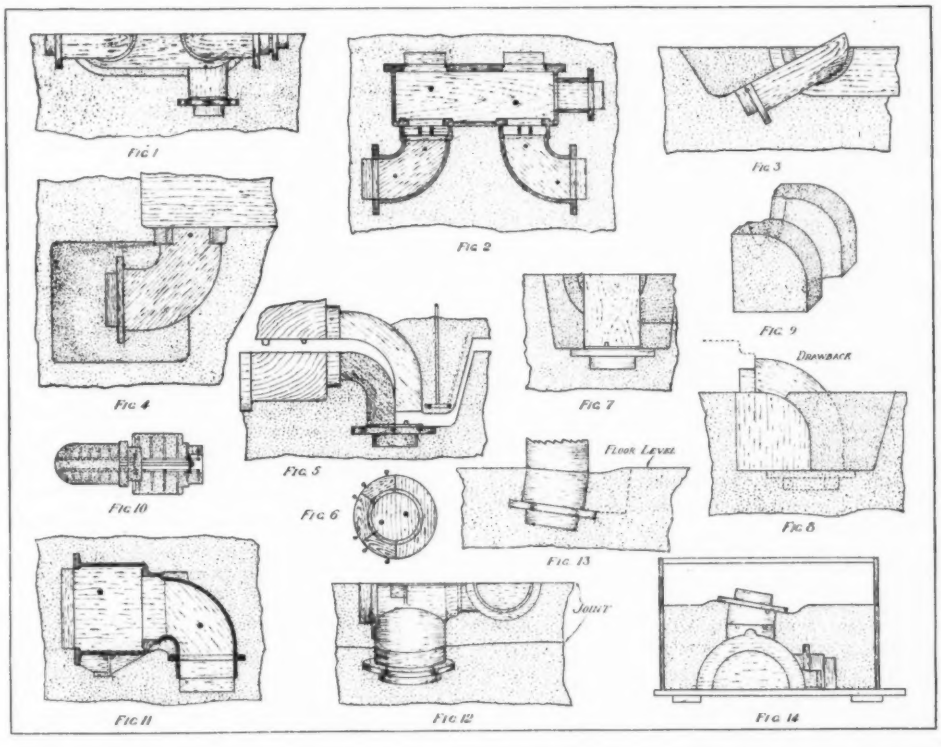
The two constituents, silicon and manganese, are the principal ones occurring in cast iron, forming series of solid solutions. On this account any increase in the concentration of these constituents in cast iron would be expected to be accompanied by a gradual increase in hardness. This increase is an intrinsic influence of these elements, and is independent of their influence on the condition of the carbon. This intrinsic influence has been clearly shown by Hague and Turner, and by Coe in the case of manganese.

* J.I.S.I., Carnegie Memoirs, 1916.

Some Large Marine Valves.—Part II.

By Ben Shaw and James Edgar.

As in other branches of engineering, the metal of which valves for marine work are cast varies. The smaller types are generally of brass, although a good-quality brass is generally necessary; for larger valves, however, cast iron, bronze, or steel may be used. The choice of material depends upon many factors with which the foundryman is not usually concerned, as he is rarely required to define whether the valve is to be of ferrous or non-ferrous metal. He is, however, frequently required to vary his mixtures of bronze or cast iron to suit the valve to be cast, and, in order to be able to do so, he should have some knowledge of the purpose for which a particular valve is to be used and its conditions of service. For many types of valves, particularly those that are to be of bronze or gunmetal, the composition is



given on the drawing supplied together with certain stresses the metal mixture must register under recognised tests. Invariably, whatever the metals to be used, good mixtures are desirable even when the pressures to which the valves are to be subjected are low, because replacements are not readily obtained or because of the cost involved in obtaining replacement away from a home port. Sound castings, while desirable for all work, have a special significance when applied to valves whether for marine or any other work. Valves are simply control centres, varying in their degree of importance, and sound castings are a necessity. Castings should be as free as possible from internal stresses, and a fracture of the metal used should be close and fine in texture. Mixing by analysis is necessary for bronze and steel, and is very desirable for cast-iron mixtures. While it is not possible to deal with all valves used, the choice of definite types will not only give a guide to the general moulding practice, but also serve as a guide in coping with suitable mixtures of metal for work of a similar character and subject to similar conditions of service.

The valve chest represented in Fig. 2, the patternmaking for which has already been discussed, is a typical example of a marine job, the design of which is usually varied from those used on other engineering work because of the limited space available for connections. Branches are consequently required at very awkward angles, yet so shaped that they offer the least possible resistance to the flow of water or steam. In this example, the centres of three of the branches are in the same plane as the valve spindles, a fourth branch being at right-angles to them. Apart from the fact that this latter branch frequently varies in shape to maintain a suitable area, the valve chest, as represented, is about the simplest of its type from the moulder's point of view. When the valve chest is required to be of cast iron, the foundry floor is generally used instead of a drag part, although the turnover method is more satisfactory, particularly when one of the branches is cast down. Rarely is more than one or two castings of similar design required, therefore special box equipment to deal with them is out of the question, and, failing a suitable stock box, the floor is invariably requisitioned. There is no real difficulty in bedding such a job into the floor, because it is accessible for ramming. The presence of the branch sometimes causes trouble because it is desirable that it should be loose. When this branch can be secured to the main body of the pattern, and the screws are accessible from the joint, bedding-in is simplified. Many moulders bed the pattern down to form a bearance for the flange of the vertical branch and the extremities of the remainder of the pattern afterwards weighting it and completing the drag by ramming. This method certainly holds the vertical branch in its relative position, and screws that hold it to the body can be removed; the flange sections and side pieces to free the branch, being loosened as ramming proceeds, but branches of this kind do not, as a rule, have the joint branches very securely held, and, consequently, the application of the hammer, when adopting this method, is frequently responsible for changing their relative positions. When this is likely to occur it is convenient to secure a couple of battens to the pattern joint and simply bed a surface for the flange of the vertical branch, allowing the battens to rest on the floor. Under the pattern is then more accessible for ramming, and since

weights can be applied there is no likelihood of the loose branch being misplaced when the screws are removed. Fig. 1 gives an imaginary view of the half-pattern bedded in the floor, and Fig. 2 is a plan view of the joint.

The job becomes more difficult to mould when the branch bends are at an angle to the body centre. Frequently they are fixed by means of a semi-circular tongue which allows for adjustment to suit the angle required. The same method of bedding-in can be resorted to, but the joint surface must be shaped to follow the centre of the branches. The form of joint is indicated in Figs. 3 and 4. It is advisable to use lifters when preparing the cover, and obviously it is necessary to loosen these branches and strip them before the main pattern section is withdrawn. Valve chests, it will be realised, give more trouble when the branch bends are at such an angle that the flanges are in the same plane as the joint of the body. In determining the form of joint, much depends upon the pattern construction. It is better if the joint of the branch pattern and mould coincide, but small branches are invariably made solid because of the difficulty in fixing them when in halves. Fig. 5 shows the joint made to the inside of the flange. In this instance it is not a necessity, because the joint could be formed at the level from which the branch straightens out providing the flange is cut into sections for drawing into the mould, but it is more convenient because the flange is more accessible. Only part of the flange needs to be loose as shown in Fig. 6. To carry the lift in the cope it is advisable to use a grid securing it firmly to a box bar to give rigidity.

When the lift can be made with reasonable security a good bearance should be given, as in Fig. 7, and the sides should be well tapered. Silver sand slicked over the joint sides will materially aid the parting. Unless the lift is comparatively safe when carried with the cope, a drawback should be made. Generally, a drawback would be preferable because of the greater convenience in assembling. Lifts of this nature are frequently attempted when the cover engages the drag before any guides register and, unless very great care is taken, a crush is inevitable. The use of a drawback, as shown in Fig. 8, is much safer and does not involve additional labour. Although the bottom half of the branch pattern may be blocked off, and the shape carried in a core box, it is not very often done. Such a practice simplifies moulding, however, as, in addition to providing the joint surface for a drawback, it opens out the flange. The method could be adopted profitably more frequently than it is. The core to form this part of the mould is shown in Fig. 9.

For this type of valve chart the branch cores are generally made separate from the body core. An exception to this practice is frequently made with regard to the end branch, the position or shape of which does not often vary. The vertical branch core should be accurately shaped so that it follows the contour of the body core. Sometimes these cores are left flat, to be rubbed by the moulder when coring up, but it is never a satisfactory job. This core does not require to be secured to the main core, but the cores for branch bends should be properly secured, not only to support the branch cores, but also to maintain the position of the body core when casting. The branch cores must be made in halves so that the valve guides can be withdrawn, but they should be fastened together while green unless they are large, when they are more conveniently fastened together when dry. These cores may be located in the mould after the body core has been set, a method that is preferable for large chests; but it is necessary to secure them to the main core and hook bolts should be used for this purpose in order to engage the grids. Chaplets are sometimes used and, in some cases, they cannot well be dispensed with, but their use should be limited as far as is possible. Before trying the cover it is advisable to either ease the ends of the cores or cut back the prints in the cope, the latter for preference. This should be done even when the centre of the branches coincides with the joint of the cover box, but, obviously, when the branches are angled it becomes a necessity, unless they are turned up towards the cope. This type of casting is run quite satisfactorily at the end of the chest free from a branch into the main flange, the body, and a branch flange. Risers can be advantageously used at the centre of the main flange and from the branch flanges when the casting is required to be similar to that shown in Fig. 2, but are excluded when they are angled to a position that is more nearly horizontal.

The valve body, shown in Fig. 11, is a common type. They are either cast in bronze or steel. They may, of course, be required to be of cast iron, but more generally either of the former metals. Bronze is common for small or even medium-size valves, while the use of a steel casting predominates when of large size. It is the twisted branch that gives some little difficulty in this case, making the use of a special joint desirable. With a deep enough box part to form the drag, it would be possible to prepare a two-part mould by using a loam cake. This method would, however, necessitate more than ordinary care in ramming, because part of the branch, as well as the flange, would need to be stripped before setting the core. Both bronze and steel chests of this type are frequently cast with the body flange uppermost, this method giving better facilities for suitable risers or heads, and the resulting casting is more likely to be sound. In order that this can be done, the mould must be made in box parts. When the mould is to be cast in the position in which it is prepared, the foundry floor is often used for part of the branch as shown in Figs. 12 and 13. In this position the metal is not so conveniently run. Many moulders prefer to make a tangential runner into the bottom flange and, for this purpose, make a drawback, as shown by dotted lines in Fig. 13, for greater convenience in making a connection with the ingate. This method of running is quite a good one providing supplementary runners are made to the body on the joint line.

The use of the foundry floor for such work is simply an expedient, and does not offer the advantages that are associated with boxes. The bottom pattern section can be located on a bed or ramming board in an inverted position, as in Fig. 14, in which position it is more conveniently rammed and the joint can be formed at the back of the flange as shown. When both box parts have been rammed, the whole can be turned over for the preparation of the cope. The mould, when completed in box parts, can be transported to an oven for drying.

The preparation of the cores for such a job is not very difficult. The use of a full core-box would, from the core-maker's point of view, be the simplest, but it is an uneconomical method. A skeleton half-box with facilities for strickling the top is generally preferred to a plate or frame, because the whole of the core can be completed. Failing this, a core frame is better for stripping than a plate, and the two parts of the core can be made quicker as, directly one plate has been made, all the frame parts can be removed and assembled for the other part core. It is, of course, necessary to reverse the core frame. The grid should be so arranged and of such a shape that the branch core can be fastened when both are located in the mould. This is not essential when the mould is cast horizontally though it is desirable; it is, however, a necessity when the mould is cast on end. For either bronze or steel castings chills are desirable to extract the heat from thick sections quicker than other parts and so equalise the rate of cooling. In addition to chills, thin ribs should be cast connecting the flanges with the body to reduce possible distortion in cooling. While the principles involved in the preparation of moulds are similar, whether they are to receive cast iron, bronze or steel, slight modifications must be made to suit the metal used. Moulds for steel, for instance, in addition to being formed of a highly refractory sand, such as red rock or Trent sands, or "compo," are nailed to a greater extent than for cast iron or bronze, and particularly is this necessary over the areas near to the runners. The omission of this precaution will invariably cause the casting to be scabbed.

(To be continued.)

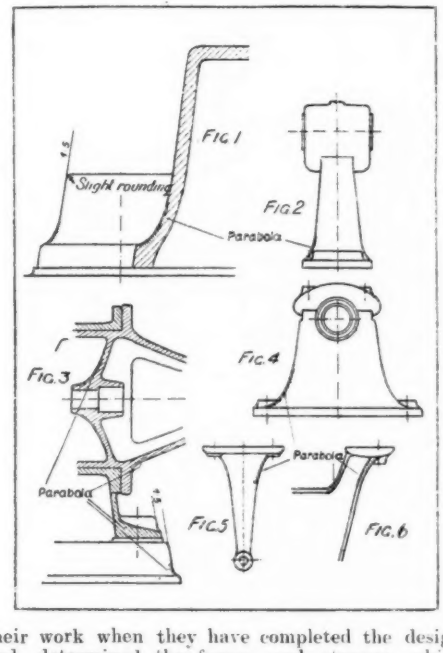
The Production of Castings—with special reference to Iron Castings.*

By Robert Lehmann.

[In connection with the prize competition on the above subject organised by the Association of German Iron Foundries an endeavour is made in this Paper to outline principles for the correct construction of castings in relation to material, moulding, casting, and cleaning. The Paper was awarded a prize.]

INTRODUCTION.

The result of proper co-operation between drawing office and engineering workshop, which has been greatly promoted during recent decades, was essentially to direct consideration when designing the constructional parts of a new machine, etc., to their actual manufacture and to the machinery or apparatus available for the purpose. Even to-day, however, the conditions are unfortunately quite otherwise in foundry work, not only in small but also in many large works. As compared with engineering workshops, the foundry is scarcely considered when the design is begun. Once the drawings are finished the making of the patterns is left to the pattern shop. The reason of this is that most designers think that they have finished



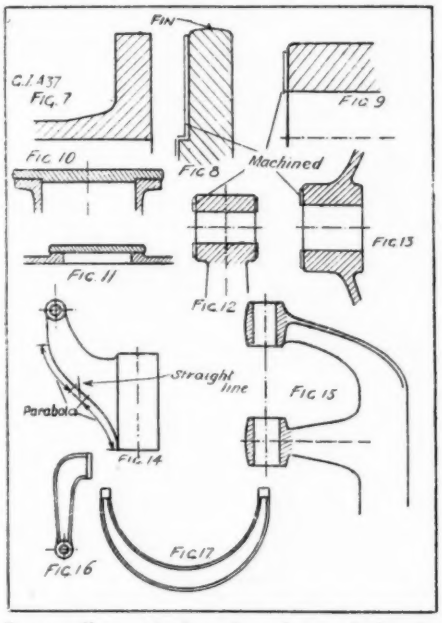
their work when they have completed the design and determined the forces and stresses which occur. They do not take into consideration the further requirements of the foundry and the fact that higher stresses may sometimes occur in the casting owing to faulty dimensioning or shaping. They do not know the difficulties of the foundryman; the delivery and the jointing of pattern and core box are not, or only superficially, taken into account. The designs thus produced can no doubt be executed, but in the pattern shop and foundry they entail much work, and consequently involve needless expense.

In most cases the foundryman has not sufficient knowledge of designing to give advice as to suitable construction. It is generally only in the finished pattern or during its production that the foundry manager recognises the presence of faults; at the same time, the costs of design and pattern are already so high, and so much of the delivery period has already elapsed that in most cases no alteration is made. But even if the foundry manager submits a suggestion in good time, the designer in many cases declines to entertain it; notwithstanding the higher cost, he has the more difficult design executed merely to save himself the trouble of altering it.

* Translated from "Die Giesserei."

The position is particularly unsatisfactory in the case of firms which have no foundry. These firms are not acquainted with the technical achievements in foundry work, and this reacts on the foundries which supply mainly stock castings. The patterns used have generally been produced by a third firm, and, of course, show every conceivable defect. In most cases the pattern firm has no interest in simplifying the patterns, as this would involve reducing the sale price by half or more. The pattern is executed according to the imperfectly-prepared design, and in addition to double the price for the pattern the customer has frequently to pay double for the casting, while his competitor pays a fraction of the sum for a similar, but well-made, casting.

All these defects are eliminated or mitigated if those responsible are informed as to the most important points to be observed in the foundry, and take these into account when determining the design. It must always be borne in mind that faults should be eliminated at their source, *i.e.*, during the preparation of the design, and not subsequently by indirect methods.



In a well-organised works, when a design is to be prepared, the works manager, the foundry manager, and the standards engineer should be called in, with a view to finding a good practical solution whereby a saving may be effected in the widest sense in the pattern, in the foundry, and in the workshop.

If pattern and casting are produced elsewhere, then, after the design has been completed, but before preparing the working drawings, representatives of the firm concerned should be consulted and their advice followed.

To-day more than ever it is necessary to eliminate every needless operation; even drawing offices must work on economic lines, and if the following statements contribute to this end the writer will have achieved his purpose.

Constructional Data.

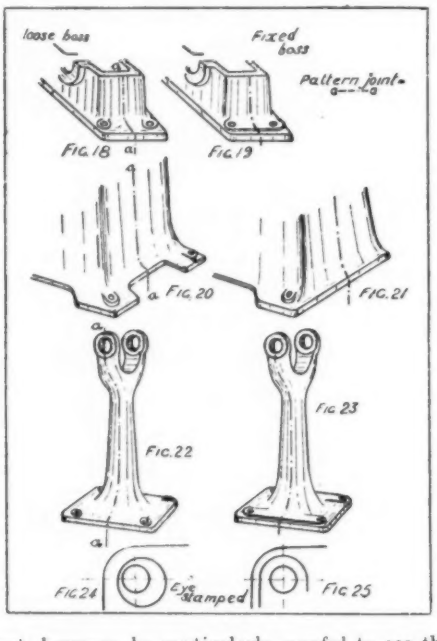
The preliminary design is prepared on the basis of the data supplied and the intended use. The cross-sectional form of the design to be executed must, of course, be in accordance with the rules relating to strength of materials. The cross section must be selected in dependence upon the manner in which the casting is stressed, whether only in one or in various directions.

The principle that every structure should be carried out with the lowest weight admissible should be applied.

To enable these and other requirements to be fulfilled, the designer must have certain knowledge or experience, particularly of the following:—(1) The strength properties of the various constructional materials used by his firm (between foundry and drawing office agreement must exist as to the materials to be used*); (2) the ratio of compressive strength to tensile strength; (3) that the bending stresses differ greatly in the individual cross-sectional forms; (4) that the strength of a rough bar is less, owing to the skin; and (5) that the strength decreases with increases in temperature, etc. (See Bach's experiments.)

Shape and cross section should be then so determined that the casting shall have an exterior appropriate to its purpose. It must, therefore, be considered in each case whether ribbed or hollow casting is most suitable. Hollow casting gives a good stable appearance and close-fitting parts and permits of rapid cleaning; it should be preferred in cases where, in addition to adequate strength, a pleasing shape is a necessary consideration, as, for instance, in machine tools, driving gear, etc., which are permanently visible. Ribbed casting, on the other hand, should be employed where minimum weight, lowest cost of pattern, and cheapest casting are desired.

No definite rule can be laid down regarding this point at the outset; it must be decided in each case individually by the designer himself. He must, however, be particularly careful to see that hollow casting is never combined with ribbed casting where it would be visible.



Cross Section.

Further, the designer must know what is the minimum wall thickness required to enable the foundry to make the casting at all. All foundries do not work uniformly; what is possible for one foundry is impossible for another.

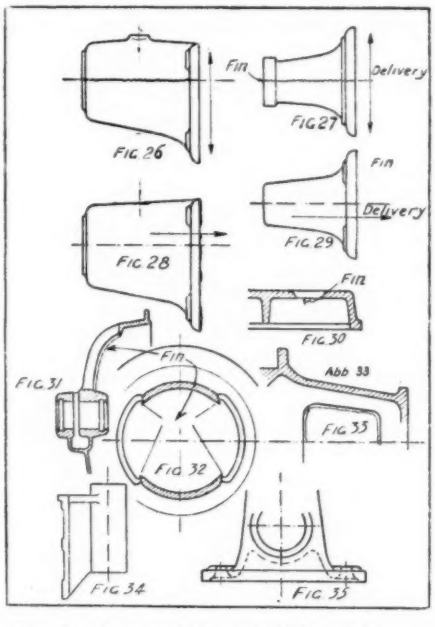
A certain wall thickness is necessary, irrespective of the action of external or internal forces:—(1) In castings designed to obtain an enclosed chamber, casings, containers, etc., here density is a special requirement; (2) in castings for the chemical industry or for furnaces—for these a particular composition is necessary owing to the action of acids or on account of refractoriness; and (3) in castings liable to rust, pipes, etc.

A certain wall thickness becomes necessary owing to the effect of external and internal forces in (1) all transmission elements; in these the cross section of the casting must be selected in accordance with the direction of forces; (2) castings subjected to high internal pressures from liquids or vapours, *e.g.*, air vessels; (3) castings which, in addition, are subjected to wear due to friction, such as steam cylinders, etc.—here a special cast iron must be selected; (4) revolving parts which are subjected not only to the stress due to energy transmission, but also to centrifugal forces (flywheels, winding drums, belt pulleys); (5) revolving parts which are subjected, in addition, to heat stresses (turbine wheels); and (6) revolving machine parts which are also subjected to wear due to friction.

These points must be taken into account. The designer should, however, also get a clear idea of all the processes connected with the production of the casting from the foundry to its installation.

This involves the following questions:—(1) How do pouring and contraction proceed? (2) What is the rate of cooling? (3) What part of the casting keeps hot longest? (4) Where may cracks and pipes occur? (5) How may casting stresses be obviated? (6) How may the casting be cleaned, and what stresses are thereby set up? (7) What may occur during conveyance from one workshop to another? (8) How is the casting to be fixed for machining? (9) How is the machining itself carried out? (10) Can any internal stresses occur and to what extent is the casting itself stressed thereby, especially when fettling? and (11) Are bosses or holes necessary for machining, transport, fitting and removing?

If large castings are concerned, the following questions must be examined:—(1) How will the casting be transported? (2) What lifting gear has the customer at his disposal? and (3) How far is it possible to produce the casting in one piece?



All these questions are of the highest importance as regards the shaping of pattern and core: in most cases, indeed, the recesses to be provided for fitting or transport purposes are of advantage to the casting, as any holes present may serve simultaneously as bearing for the core.

External Form.

The casting should not only be in accordance with technical foundry requirements, but must also have a pleasing external form. In preparing the design it is necessary to take into account the taper for delivery purposes, 1 : 20 to 1 : 30. For bosses 1 : 5 may serve as a standard. All bosses, wall, cover and base plate connections to the limb of the casting, and the connection of bosses to solid centres, etc., should not be limited by an arc, but always by a parabola (Figs. 1-6).

With regard to the connection of flanges to cylindrical bodies, the German Engineers' Association has fixed the standard 376 (Fig. 7).

A flange cover, Figs. 8 and 10, the corresponding closing piece, Fig. 9, or the cleaning cover, Fig. 11, should have a diameter several millimetres larger and, as far as possible, a rounded

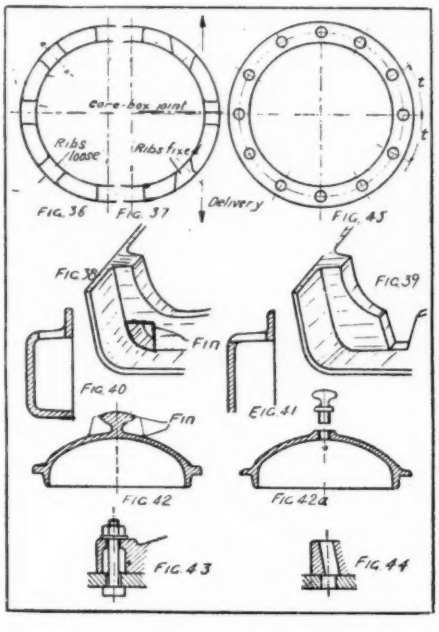
* The strength of standard cast iron is now only one-third of that of a high-grade cylinder special iron.

form (Fig. 8). The intentional increase in the diameter renders inconspicuous any inaccuracy that may occur in the diameter of the flange, and extra work in the machine shop is avoided. As fin formation is but slight, the cleaning shop has less work; the broad flange faces need not be ground off, but only the tip; and, above all, in cleaning a perfectly rotary form is retained.

Bosses which require to be machined only on the front face should be rounded off and provided with a working face at the outset (Figs. 9, 12 and 13). In transitional forms, as in Fig. 14, both the upper and lower connection should be a parabola with the interposition of a straight line. All parts of the casting should be executed as bodies of uniform strength (Figs. 14-17). The designer must ascertain whether the casting is to be moulded by means of pattern or template or entirely as a loam casting. The remainder of this article deals with castings for which a pattern is required.

Bosses, Ribs, Guide Strips.

The design should be carried out in such a manner that all eyes and ribs can be firmly fixed to the pattern. The designer must adapt the execution to the jointing of the pattern. This also applies to the internal form of the casting, the core or the core box.



If the bosses are loose and if the bolt hole is to be cast or drilled with a particular interval between the holes, then the hole will generally be displaced to one side, as the boss has not been stamped with sufficient care (Figs. 18-25). The same thing occurs with loose ribs on the pattern. On the finished casting these are out of place or slanting, and they have often to be worked off again, as one or other of the ribs happens to come too close to a bolt.

A further great disadvantage of loose hollow bosses and ribs is that they are often lost in the foundry and on the way to the pattern store. When again required, new ones have to be made. In many cases cored holes should be avoided from the outset.

Pattern Jointing.

The design should be executed with a view to the greatest simplicity of form and of pattern jointing. The bearing shown in Fig. 26 should be preferably executed in accordance with Fig. 28; here the boss may be dispensed with. If the pedestal is executed in accordance with Fig. 29 instead of Fig. 27, the bosses are delivered at the same time; the edge of the fin disappears in machining or may be cleaned off without affecting the shape. In general, special attention must be paid to the fin edge. It must be possible for the cleaner to work off the whole of the fin with grinding machine, chisel, file, etc. The joint or fin edge must be placed in such a manner that the external form of the casting is subjected to as little stress as possible (Figs. 30-33).

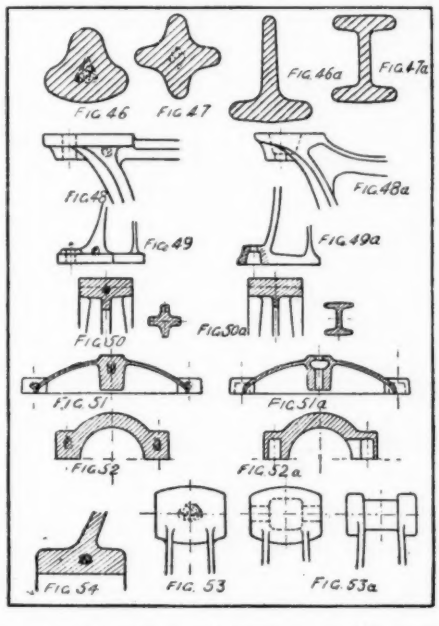
Even simple castings show that substantial advantage may be obtained by correct arrangement. The more complicated the castings are the more consideration is necessary. For holes in covers, plates, etc., the edges of the fin must be so placed that the external form is not impaired in cleaning. The shape should be such that a sharp fin is produced (Figs. 30-33).

If at all practicable the guide strips should be arranged so that they may be lifted out (Fig. 34). If the construction does not permit of this, or if a core is required for a recess, the guide strips may also be set in the core (Fig. 35).

Cores.

In intimate connection with the jointing of the pattern and the fin edge, the shape of the core or the jointing of the core-box has to be determined. Core-box and pattern must mutually supplement each other; very often the design has to be altered with a view to better construction of the core-box.

As in the pattern, so also in the core-box, the ribs and eyes must be fixed (Figs. 36 and 37). The proper delivery taper must be provided at the ouset. The thickness of the cores should not



go below a certain minimum. In the case of castings with complicated cores, the designer should know whether and where core irons, vent holes, etc., have to be arranged or left. The casting must be so constructed that as few individual cores as possible result. The separate cores should be combined to form a single core; this enables them to be made better and facilitates setting. The cores require prints, which should be selected so as to ensure a reliable bearing for the core. All core bearings give rise to fin formation. If at all practicable the core bearing should be set into a face which has to be machined in any case, or otherwise into a face which is easily accessible for hand working, chiselling, filing, etc. The casting should be so constructed that even when the fin is imperfectly removed the external form is not affected. Examples of this have already been given in Figs. 30-33. If the core bearing is made by core bonds, caution is necessary, as these are liable to cause spongy parts, etc., particularly in castings subjected to high pressure, such as air vessels.

In closed constructions, openings must be provided, through which the core sand, as also the core irons, may be removed (*e.g.*, cooling-jacket cores). The cleaning of the core cavities frequently presents considerable difficulties, especially when the core sand has to be removed completely, for example in cases where the cavity is used as

oil container, as in bearing shields (Fig. 31) and similar parts. In such cases special methods must very often be adopted, such as cleaning out with acid, blowing out with steam, etc. The designer has it in his power to restrict these drawbacks to a minimum, and in certain cases even to obviate them entirely, by dispensing with cores. By modifying the designs in Figs. 38 and 40 in accordance with Figs. 39 and 41 the cores are eliminated. A design such as that in Fig. 42. "a cover with knob" should be rejected; the design according to Fig. 42a, in which core and fin are absent, is preferable for the purpose. In mass production revolving parts become cheaper than the core plus the time taken in its insertion. The shape of the cover as well as of the knob, according to Fig. 42, is greatly injured in cleaning. It happens not infrequently with such designs that the knob gets knocked off in the foundry, during its transport or even after machining, and the casting is then wasted.

If the core cannot be supported by two or more bearings a certain amount of displacement must be reckoned with from the outset. Displacement or obliqueness of the core can be remedied by locked cores (Fig. 43). In connecting the parts in question only the slight thickness of the upper drop has to be reworked, but not the long oblique hole (Fig. 44). If cores are used for connecting bolts, these are also used as recess cores to economise material, and the formation of pipes is at the same time avoided (Figs. 48*a*, 49*a*). In castings such as that in Fig. 45, in which a considerable number of cores have to be used round the circumference, but which must also be identical with each other to permit of interchanging or employment in pairs, the cores should be so dimensioned at the outset that a certain displacement may take place without reworking being required if the holes are to remain rough. Where the holes are machined, however, the cores must be sufficiently small so that even if displacement occurs in the foundry there is sufficient material for machining. The foundry must be asked to attend to the matter as far as may be practicable, and the construction of the pattern must be such as to make it possible to obtain the necessary accuracy.

It is necessary that the utmost care should be given by the foundry to the making of the cores. The core must be accurately dimensioned and sufficiently strong to withstand transport; on being inserted it must not show any injury or even a fracture, as this gives rise to fins on the casting.

Piping and Cracks.

The most difficult parts of a casting for the designer and the foundryman are those points where several walls meet. With incorrect dimensioning or shaping of the transitional points piping occurs. The outer wall cools, while the inner wall is still molten or plastic, and may still draw. If the surrounding wall has already cooled on all sides, then a loose structure or a pipe is the result. Such pipes occur:—

(1) With faulty cross section (Figs. 46, 47); (2) at points of connection (Figs. 48, 49, 50); (3) in bosses of small castings (Fig. 51); (4) at points where reinforcements for the boring of holes connect (Fig. 52); (5) in eyes which are cast solid (Fig. 53); and (6) in bosses of large castings if no openings are provided (Fig. 54).

The figures marked (*a*) show suitable alterations. The maxims: "Avoid all 'lumps' of metal," "Strive for uniformity of wall thickness," ought to be inscribed in large letters in every drawing office. Where lumps of metal are unavoidable the foundry must come in and help by inserting chills, placing suitable risers, rapid quenching, etc. To what extent the formation of pipes can be allowed must be separately considered in the case of each individual design.

(*To be continued.*)

SPEAKING AT MIDDLESBROUGH, Mr. Charles Dorman said that the men in the iron and steel trade had never worked better than at the present time. Productive costs were only 25 per cent. above the pre-war level, and all honour was due to the men who had brought about this state of affairs. It was essential, however, for the recovery of trade that costs should be further reduced, and he instanced in this connection the heavy burden which taxation imposed upon industry.

Mr. Allan John Grant.

Elected to the Board of Davy Bros.

In the annual report of Davy Bros., Limited, the directors announce the impending resignation from the board of Sir William Ellis, who has for many years given valuable service to the company. Sir William has been elected to the presidency of the Institution of Civil Engineers, a position placing additional work on his shoulders, and he feels quite unable to give the time to this company's affairs which he considers imperative in the present state of the industry. The directors state that at the suggestion of Sir William they have elected Mr. Allan John Grant, director of John Brown & Company, Limited, to a seat on the board. The directors also report that in April last Mr. Frederick Charles Fairholme, of the firm of Thos. Firth & Sons, Limited, was elected a director of the company.

MR. A. J. GRANT.

Mr. Grant is also a director of various companies connected with John Brown & Company, Limited, such as Cravens Railway Carriage and Wagon Company, Limited, Nasmyth, Wilson & Company, Limited, the Trent Iron Company, Limited, the Carnforth Hematite Iron Company, Limited, and the International Shipbuilding and Engineering Company, Limited, of Danzig. He is a member of the Institution of Naval Architects.

Personal.

MR. A. CORKER has been elected a director of the Midland Iron Company, Limited, in place of the late Mr. W. H. Micklethwaite.

MR. L. P. SIDNEY, M.B.E., who has acted as assistant secretary to the Iron and Steel Institute since 1904, has just resigned. Mr. Sidney, who was formerly chief metallurgist of the Shelton Iron, Steel & Coal Company, Limited, was for some years sub-editor of our contemporary, THE IRON AND COAL TRADES REVIEW, and afterwards reader to Charles Griffin & Company, Limited. Mr. Sidney has resigned in order to devote his time to his extensive practice in technical journalism.

Will.

SAMPSON, J., of Queen Anne's Mansions, Westminster, S.W., for some years director of Thomas Firth & Sons, Limited, and of John Brown & Company, Limited £75,412

THE WHOLE PROBLEM of the present day in the engineering industry was the production of the foreman, said Lt.-Col. E. Kitson Clark, speaking at the annual conference of the Association for Education in Industry and Commerce at Leeds. They wanted men of character in the engineering industry, men with minds not machines. One of the greatest needs of the present time was the understanding of costs.

Feeding Ingots.

BY "CELSIAN."

On account of the numerous factors adversely influencing the production of sound non-ferrous ingots, it is of the utmost importance that efforts should be made to make use of, as far as existing conditions will permit, any improved methods available.

In the old method of casting whereby the liquid is injected into the moulds, the impurities or foreign matter on the surface are run into the mass with a quantity of air. The greater part of the air is imprisoned, on account of the rapid solidification which occurs.

Another drawback is that the agitation, unavoidably incurred during injection, results in thin layers or spots being splashed on to the sides of the mould which are usually completely solidified when the mass covers them. In consequence, skin faults are produced causing trouble and loss of metal during casting. By the foregoing method the maximum surface of the liquid is exposed to the atmosphere, consequently oxidation rapidly takes place. In addition, defects such as blow holes, caused by the air, and bubbles from the gas given off from some foreign material are certain to be experienced.

As is well known, when the molten metal has been poured into the mould it at once begins to solidify, and at the same time the mass begins to decrease in volume. As shrinkage is directed towards the sides of the mould and away from the centre, a hollow is left which, unless filled up whilst the metal is still molten, will result in the production of blemished or useless ingots. Of course this hollow is anticipated, and preparations are made to refill it. This is accomplished by feeding the ingot in the following manner.

When the mould at first appears to be full, the metal seems to sink, due to the shrinkage in the direction of the sides. In order to produce a sound ingot it is necessary to continue adding the molten metal in an uninterrupted stream as long as the apparent sinking of the liquid continues. The degree of shrinkage depends largely on the temperature at which the metal is poured; molten metal, like other liquids, being controlled by the laws of expansion and contraction. Unless feeding is properly conducted a cavity or pipe will remain.

Piping more frequently than other factors is responsible for the production of imperfect ingots. Other troubles are encountered which also affect production adversely, viz., slag, oxide, or gas occlusion. Although piping may not be altogether eliminated it can, to a large extent, be reduced by the procedure now followed out for "feeding" the ingot.

Casting of Steel Ingots.

Great improvement has been experienced since the introduction into general use of the "feeder head" or "dozzle," a contrivance made to fit into a recess in the mouth of the mould for casting steel ingots. Previous to casting, the dozzle is made white hot and, as rapidly as possible, is inserted into the top of the ingot mould as soon as the teemer has filled it. This is a troublesome matter and requires skilful handling. Whenever the liquid in the centre of the ingot begins to sink the molten metal in the dozzle is gradually drawn upon to feed the cavity as it develops. The hot dozzle is practically a secondary crucible. It holds the metal in a liquid condition sufficiently long to permit it to be sucked into the interior of the ingot as long as the hollow, caused by the shrinkage, requires to be fed.

During the casting of steel ingots, the teemer, standing at the side of the ingot mould, directs the stream of molten metal into the mould, till it has reached the top, by balancing his pot. Without loss of time another worker inserts the square or rectangular fireclay feeder-head or dozzle into the mouth of the ingot mould before the metal in the interior of the mould begins to shrink. The caster then directs his feeding stream inside the dozzle until the latter is completely filled ready to be absorbed by the pipe which has begun to form in the centre of the ingot. Unless the metal is poured without intermission into the mould it will be sucked into the pipe hollow in separate particles. When the metal is poured in a spasmodic fashion occlusion of gas, oxides, or slags is almost certain to be produced. This is not the worst trouble encountered by careless pouring of the metal. Unnecessary delay in the feeding operation reduces the temperature of the metal to such an extent that it immediately solidifies as it comes in contact with the already cool metal inside the mould. Unfortunately this results in the lower part of the ingot developing an unfed pipe hollow of considerable dimensions while the upper part has the deceptive appearance of a sound ingot.

Casting of Non-ferrous Ingots.

Non-ferrous work, however, has entered on a new era which should prove instrumental in minimising the number of cast brass ingots relegated to the scrap heap. One authority recommends a mode of procedure which does not differ, to any great extent, from the usual practice of brass ingot casting but which reduces the amount of labour employed. The moulds are placed as nearly vertical as possible. Having previously been made white hot the dozzle is inserted into the recess constructed in the mould to receive it. The metal is not poured into the moulds until the contents of the crucible have been skimmed free from impurities, after being advantageously placed for pouring. The stream of metal is then directed by the caster towards the centre of the mould, the dozzle taking the place of a kind of passage through which to guide the metal. At a regular rate the teeming issues in a steady stream until both mould and dozzle are completely filled. In this way the operations are completed without resorting to feeding. When properly proportioned the capacity of the dozzle should be sufficient to feed the ingot pipe and leave a small piece over as "gate-end" which can readily be cut off. In this way the feeding of ingots is mostly mechanical and consequently more to be depended on for uniformity and speed in pouring than that attained by individual effort. By maintaining an equal and constant stream of the molten metal throughout the process the risk of untimely oxidation is reduced. In the foregoing method the metal is less susceptible to the occlusion of gas and the slag rises freely to the surface.

As the aperture in the mould is so constructed that the dozzle lies flush with the upper edge, teeming in the usual manner offers no difficulty. By the use of the dozzle, when properly proportioned, considerable saving may be secured, by the reduction in scrapped "gate-ends."

Still further progress has been made in ingot production by a method which claims to be the means of preventing the usual troubles experienced in casting, particularly in those metals which are more easily oxidised. In this method skilled labour, with all its drawbacks, is entirely dispensed with. The dozzle is only sufficiently heated to make it dry, which facilitates handling when it is placed in position before the mould is filled. It is automatically heated when the molten mass passes through to the mould while casting is taking place. The molten liquid is poured through the dozzle into the mould by a pocket-shaped ladle, lined with refractory material when essential, or left bare in accordance with the nature of the metal used.

The casting operations and filling of the ladle are, as a rule, entirely carried out by the help of a travelling crane. The ladle is first filled up to a certain level with the molten metal which is allowed to settle down and cool till it attains the lowest temperature at which it is still liquid.

As the majority of impurities are lighter than the metal, they readily rise to the surface and, during the period of settling in the ladle, there is sufficient time to carefully skim off any slag, etc. After skimming, the whole apparatus is tilted to a level at which the dozzle is half full and the tilting continued till the mould is perpendicular when the ladle automatically fills the mould and dozzle. After the stripping of the ingots takes place, the dozzle is re-adjusted and the process begun over again.

In whichever method dozzles are introduced the principle underlying the practice in each case is the same, *i.e.*, the dozzles retain the molten metal for "automatic feeding."

XUM

The Testing of Cast Iron.

An interesting lecture, entitled "The Testing of Cast Iron," was recently given by Mr. C. Dickinson, B.Met., to the members of the Sheffield Foundry Trades Technical Society.

Mr. Dickinson pointed out that finished castings are sometimes subjected to special tests, but these vary considerably. In general, they attempt to copy the conditions under which the specimen will have to work. For instance, the drop test is usually carried out either by dropping the casting several feet or by allowing a weight to fall on it. Another special test is the steam or water test, where such castings as cylinders or pipes are filled with steam or water under a definite pressure. Any leakage or sweating of the casting in this test will condemn it.

The most usual method of obtaining a test of cast iron is to cast special bars quite separate from any particular casting. This method, however, is rather a test of the metal used than of the actual casting. It is obvious that a small casting such as a bracket or firebar, and the large one, such as a 20-ton engine bed-plate, although cast from the same mixture of iron will not have the same mechanical properties. The small casting having cooled quickly in the mould, will have a very fine structure, and will be in consequence both brittle and hard. The large casting, on the other hand, will have taken a considerable time to cool, and will therefore be open in structure and much softer than the small casting.

Continuing, Mr. Dickinson, said if two test bars were to be cast of the same shape and size to represent each a small and large casting, they would not give such comparable results, but would rather show similar physical properties. An example of the effect of the size of castings on the physical properties, might be quoted from a Paper by Mr. J. W. Bolton on A.S.T.M. Bars, in which it is stated that a one-inch diameter bar will give a tensile strength of 40,000 lbs. per sq. in., while a bar ½ in. larger in dia. will only give a tensile strength of about 32,000 lbs. per sq. in. In the extreme case that is a reduction in tensile strength of 25 per cent. These results show to a marked degree the effect of size on the properties of iron castings.

Relation of Test Pieces to the Casting.

With a standard test bar one might expect that a casting thinner than the bar would give a higher tensile strength. It would undoubtedly be harder, but its tensile strength may be considerably lower. A casting larger than the bar may—although it is not so hard as the test bar—be tougher. It will, therefore, be seen that it is necessary to use great discretion in judging the results of mechanical tests carried out on test bars and in estimating therefrom the properties of casting made from the same method. This problem of the effect of the size of a casting upon its mechanical properties is being investigated by the British Cast Iron Research Association.

Mr. Dickinson said another method of preparing test bars is to cast them on the actual castings, if possible, so that the length of the test bar lies along the length of the casting. In this way the rate of cooling of the test bar is governed by that of the testing. This method is by no means perfect, as the outside of a casting obviously cools at a faster rate than the interior, so that the test bar will be somewhat harder than the casting itself. The size and shape of test bars vary considerably with the different specifications, a fact which was illustrated by the lecturer in a reference to British and American standard specifications.

Shape of Test Pieces.

Speaking of the tensile test, the lecturer said the test piece is usually machined to a diameter of 0.564 in., or 0.798 in., which will give cross sections of quarter and half square inch respectively. One of the most important factors in the design of the test piece is the shoulder, which is formed by the junction of the shank to the centre part, and gripped in the machine. When the test piece is reduced in diameter from the shank to the centre part, which is the actual part to be tested, a radius is necessary. If this radius is too small or too sharp, the casting will probably fracture at the shoulder and the test will be useless. It is, therefore, advisable to make the radius as large as possible, even at the expense of reducing the centre portion of the test piece.

Machines Used.

Referring to the testing machines, the lecturer said there are several types, but most of them resemble either the Buckton or Armstrong-Whitworth. The former is a lever machine, and the test piece is loaded by means of weights or levers. The Armstrong-Whitworth machine is operated by oil pressure which is controlled by valves.

In the tensile testing of cast iron it is only essential to determine the maximum load at the fracture, or the greatest load the test piece will stand before breaking. The nature of the fracture should be carefully noted and blow-holes or similar flaws looked for. The tensile strength of cast iron varies from 5 tons to 18 tons per square inch. Most specifications call for not less than 12 tons. In practice, castings are rarely used where a purely tensile stress is in operation, but the test is a very popular one.

Compression Testing.

The lecturer next dealt with the compression test, which reproduces the conditions under which cast iron is more frequently used. The test pieces are practically all made 0.564 in. diameter and 1.128 in. long. In this test the crushing load is usually recorded, and sometimes the angle of shear, *i.e.*, the angle the fracture takes across the test pieces. Another factor rarely noted, but which is important, is the measurement of the amount that the test piece is shortened by the load before fracture.

The crushing load in the compression test varies with different classes of iron, the average result being about 40 tons per sq. in., although figures as low as 20 tons and as high as 80 tons have been recorded.

Almost all iron castings are wholly or in part subjected to a transverse stress, and the test where such a stress is applied to the bar is consequently extremely important. A variety of test bars are used according to the different specifications. The bars are rectangular in shape and supported on two knife edges at their extreme ends, the load being applied on the centre of the bar. The load required to break the test piece is measured and usually reported in hundredweights. The amount the bar bends is also noted just before fracture. This is termed deflection. The nature of the fracture should be noted. The transverse load is on an average about 28 cwt., on a bar 2 in. × 1 in. × 36 in. long.

Hardness Tests.

There are other tests to determine the hardness of the outside skin of the casting, and the Brinell and Scleroscope machines are used for this purpose. Another method of testing the hardness is the use of the Sclerometer, in which a loaded diamond is drawn across a prepared polished specimen and the minimum load which will produce a standard scratch noted and measured.

In conclusion, Mr. Dickinson stated that the results of tests on cast iron were generally very erratic as compared with tests on steel. This is due to the heterogeneous nature of the material. One specimen may contain constituents of such varied properties as have graphite, ferrite, cementite and pearlite, and in two test pieces of small cross section the proportions of these constituents may vary, although the pieces were machined from the same bar. The shape and position of the graphite plates at the point of fracture may affect the properties greatly. In order to be fairly sure of the tensile strength of a specimen of cast iron, the mean of several tests should be taken.

Shrinkage During Casting.

In general foundry practice it is the custom to allow a certain amount of shrinkage of castings when patterns are made, the exact figure being determined by the nature of the alloy to be cast; for example, patternmakers usually make their patterns with a certain fixed allowance of bronzes, another for brasses, and a third for aluminium alloys, irrespective of the exact nature of the alloy falling within one or other of these groups. In a foundry of the writer's knowledge it is the custom to make an allowance of 0.16 in. per ft. for shrinkage, though it is well known that the group known as "aluminium alloys" covers an exceedingly wide range, and it has been ascertained experimentally that aluminium alloys of the light type will shrink anything from 0.85 to 1.85 per cent.

When an alloy cools from the molten or liquid state to the finished casting or solid state, its total shrinkage is made up of three components—first, the liquid shrinkage, which is incurred in cooling from any temperature in the liquid state to freezing point; second, the solidification shrinkage, which is brought about in passing from the liquid state at freezing point to the solid state at melting point; and, third, the solid shrinkage, which occurs in cooling from the solid state at the melting point to any temperature below that point.

The liquid shrinkage is generally considered to be the contraction in volume of a metal in the liquid state on cooling to freezing point, and the greater the range of temperature through which the metal cools the greater will be the liquid shrinkage; that is to say, the amount of liquid shrinkage is in direct ratio to the initial temperature of the metal melted. It is thus impossible to express the liquid shrinkage of a metal as a definite value, because it varies with the range through which the metal cools from the highest temperature when molten to the solid casting. Thus it follows that the weight of metal that can be poured into a mould at a higher temperature is less than the weight at a lower temperature. This, one would think, should be obvious, but it is nevertheless not generally appreciated.

As far as solidification shrinkage is concerned, where an alloy solidifies over a freezing range, the solidification shrinkage is the contraction in volume which occurs from the beginning to the end of the process of freezing. The actual extent of this shrinkage varies very widely for different metals and alloys, and it is also appreciably affected by the presence of impurities in the metal. As far as our present knowledge goes, silicon and bismuth are the only metals which expand on solidification, but a number of alloys expand, and some even indicate expansion on cooling from the liquid to the solid state, though the total change in volume is actually a decrease.

In ordinary foundry practice the solid shrinkage may be regarded as the contraction in volume on cooling from solid metal at the melting point to about room temperature. The thermal expansivity is the reciprocal of the solid linear contraction.

The linear contraction of an alloy is synonymous with patternmakers' shrinkage. It has been stated that the shrinkage is really the difference between the length of a casting and that of the pattern from which it was produced, *i.e.*, the difference in volume between the fluid metal in the mould and the resulting casting at the ordinary temperature. If shrinkage is accepted in this sense it does not take into consideration the various stages of contraction, arrest or expansion which no doubt take place in alloys, but represents the final volume change only.

In the foundry mentioned above the allowance for shrinkage for light aluminium alloys is 5/32 in. per ft., *i.e.*, if a casting is to be 1 ft. long, the pattern is made 1 ft. 5/32 in. in length. Similarly, for grey iron the shrinkage allowance is $\frac{1}{8}$ in., and the patternmaker uses a shrink-rule, which is $\frac{1}{8}$ in. longer than the ordinary foot-rule.

Clearly, as the already enormous number of casting alloys increase in number, which they are bound to do, the arbitrary rules for allowing a definite shrinkage figure for each group of castings will become more and more satisfactory.

Manufacture of Magnesite.*

By G. H. REED.

Magnesite is essentially magnesium carbonate with which is associated impurities, iron, silica, lime, alumina, and sometimes manganese oxide.

In dealing with the crude material it is well understood that, in calcining, as much carbon dioxide as possible must be removed. Some calcine it in its rock form. The author finds it best to grind it first as fine as possible, and then make it into bricks 9 × 4½ × 3, as in this way a more even temperature is obtained throughout the kiln. The fires are slowly started at first to drive off the added water and gradually increased until a temperature of 600 deg. C. is reached. This temperature is then maintained for at least 24 hours.

The temperature is gradually raised up to 1,650 deg. C. and held at this for 72 hours afterwards to cool. The quantity of bricks depends on the class of kiln used. A small one carrying from 7,000 to 8,000 bricks is preferred. The material is next carefully selected and tested for carbon dioxide. This will indicate how it has been burnt, and also allow for further contraction at the final stage of manufacture.

The calcined bricks are taken to the mill which consists of rollers, each weighing 7 tons running inside a pan. About 12 cwts. of the calcined material are introduced into the pan with enough water to make a pasty mass and ground until 95 per cent. will pass a sieve 30 meshes to the inch. No bonding material is added, because there is sufficient with the silica present. The material can be either made into bricks direct by hand, or, if a machine is available, it must be laid up until it is suitable, three days being generally sufficient. The reason for this pasty mass is, as the lime in the raw rock is in the form of the carbonate $CaCO_3$, calcination reduces it to lime, CaO, it slakes it, thus preventing cracks in the brick. As large quantities of so-called dead burnt magnesite are used in England, it is always advisable to test, for as much as 34 per cent. of carbon dioxide has been found in some. The determination of its water or moisture content is advisable before it is made up into bricks, especially if it is made by a press. The pressure must be regulated so as to be able to put on about 80 tons per brick. A greater pressure wears away the plates very rapidly. The bricks are placed on steam-heated floors for at least seven days; afterwards they are taken to the kiln.

The kiln should be of a strong nature of the intermittent type, either single or double, the fires being arranged in the ends if a double kiln is used. The interior length of the double kiln should be 20 ft., and of the single kiln 10 ft. The height from the floor inside should be 6 ft. and the width in proportion. A greater height than this is a waste of money. The bricks are placed on end on a perfectly level floor, the first tier, hack or blade, as it may be termed, being carried to a height of not more than seven courses. A space of 3 ft. is allowed at the end for a combustion chamber. The quantity of bricks should be about 5,000 to 8,000 per kiln. The fires are started very slowly, using a poor coal at first and gradually raising the temperature to 600 deg. C. The kiln is held at this temperature for 24 hours, when the temperature is gradually raised to the highest point of the kiln, and this should be not less than 1,650 deg. C. The atmosphere should in all cases be an oxidising one, not reducing, as this lowers the refractoriness of the bricks.

During the period of burning the fires should be cleaned out once in 24 hours in the early stages, but when the top temperatures are being obtained they must be cleaned out twice. By cleaning is meant removing the slag or clinker, not taking out all the fire. The temperatures are ascertained by means of an optical pyrometer through a hole left in the doorway of the kiln.

When the kiln is finished the fireplaces are sealed up and the bricks allowed to cool slowly. The burning period with a good draught is seven days, whilst six days are allowed for the cooling down.

* A Paper read before the Ceramic Society.

Trade Talk.

THE RECENT STOPPAGE of two blast furnaces at the Tees Bridge Works, Stockton-on-Tees, of Pease & Partners, Limited, leaves only 14 furnaces producing Cleveland iron in the district.

WM. GRAY & COMPANY, LIMITED, shipbuilders, of West Hartlepool, announce that, failing further orders, they will find it necessary to close their Wear shipyard at Sunderland at the end of July.

THE RETURNS OF OUTPUT for the Clyde in June show that 27 vessels, of 43,451 tons, were launched on the river, and that of this number 17 were each under 200 tons. For the half-year the output consists of 119 vessels, of 302,957 tons, one vessel and 48,590 tons more than the total for the first six months of last year, but eight vessels and 45,519 tons less than the best corresponding period on record, that of 1913. The outlook for the industry is getting worse, as very few vessels are being laid down to take the place of those which are being launched, and unemployment is certain to increase in the near future. Very few contracts were received by builders in June.

THE SCHEME of reconstruction of Industrial Steels, Limited, which was approved by the creditors, debenture holders, and shareholders in May last, was duly sanctioned by the High Court on June 9, and the receiver appointed by the first debenture holders in April, 1924, has in consequence now been withdrawn. As has been previously announced, the Right Hon. Viscount Falmouth is the chairman of the new company, and his co-directors are Major John Greg, Mr. M. Webster Jenkinson, and Mr. A. B. Winder. Mr. A. B. Winder, who was director and works manager of the old company, has been appointed general manager of the new company, and the services of those members of the staff who have helped to bring the company to its present satisfactory position have been retained.

DAVY BROTHERS, LIMITED, in their annual report, state that the competition referred to in the previous report has continued throughout the year and orders at remunerative prices have been impossible to obtain. The contract for rolling mill machinery for the Consett Iron Company, Limited, which was taken against keen competition, has, however, resulted in a considerable mitigation of loss in general charges. It was the anticipation of this saving, whilst finding employment for the workpeople, which influenced the directors to take the extremely low price they had to face, although this involves an actual heavy loss on the contract. Provision has been made in the balance sheet by transferring the general reserve of £20,000 to revenue account for this purpose. The equipment of the iron foundry at Darnall has been completed during the year.

THE PRESENT POSITION of the Basset steel process is referred to in the report presented at the recent meeting of the Société Française des Acièries Basset, held in Paris. The report states that as the difficulties resulting from the obstacles experienced in the construction of furnace linings most suitable for resisting the chemical and thermal actions incidental to the Basset process have been solved, the directors have been preoccupied with the progressive development of the Dennemont works, which it had been desired to lay out for a large production. But the distance of the works from supplies of raw materials and from the railway rendered it unfavourable for economical production. Desirous, however, of confirming by exhaustive experiments the value of the technical process, prior to the industrial realisation of the business on a large scale, the company has applied itself to passing this stage and can now view the creation of a productive works without the fear of technical difficulties. The directors have consequently decided to establish at Mortain, on the site of the mines controlled by the company, a works for the production of pig-iron and steel by the company's processes, while the Dennemont works will resume the production of cement. During the course of further information given to the meeting, M. Basset is reported to have stated that the work of bringing the process to a successful issue had been completed. All the German patents had been obtained, following confirmations given at the Dennemont works to a commission of engineers representing the German Patent Amt. He further stated that the prime costs of producing steel by the process were from 35 to 40 per cent. less than material turned out by competitors, and that it was equal in quality to steel made in the crucible. The present output amounted to about 450 to 500 tons per month, and in the existing state of affairs the company had no interest in producing more. It was also mentioned that the new works at Mortain will probably be in operation this year, and is expected to produce from 2,500 to 3,000 tons per month.

Company News.

Ferguson Pailin, Limited.—Interim dividend, 3½ per cent. (actual) on ordinary.

Aster Engineering Company, Limited. — Loss, £13,032; total debit balance, £40,594.

Allen & Simmonds (1925), Limited, 42, De Montford Road, Reading.—Capital £10,000 in £1 shares. General engineers.

Davy Brothers, Limited.—Balance brought forward, £17,602; loss for year, £12,997; credit balance, £4,605, carried forward.

Horsley Bridge & Engineering Company, Limited.—Trading loss, £4,257; amount brought in, £4,282; net credit balance carried forward, £24.

Horstman, Limited.—Capital £10,000 in £1 shares. Motor engineers. Directors: S. A. Horstman, Onega Lodge, Upper Bristol Road, Bath; W. S. Butler, and J. W. Rooke.

Harris & Ward, Limited, Protector Foundry, Tipton, Staffs.—Capital £100 in £1 shares. Directors: H. C. Harvey and A. H. Powis. General ironfounders, etc.

Monks, Hall & Company, Limited.—Net profit, £18,000; brought in, £77,621; dividend on ordinary shares, 5 per cent. per annum, free of tax; carry forward, £83,153.

West Norfolk Engineering Works, Limited, 63-4, High Street, King's Lynn, Norfolk.—Capital £1,500 in £1 shares. Directors: R. Wharton, A. Magnus-Smith and G. H. Masters.

Mobelda Engineering Company, Limited.—Capital £1,000 in £1 shares. Directors: F. F. Mote, Abbey House, Westminster, London, S.W.; R. S. Slaveley Dale, and P. G. D. Bell.

J. F. Cross, Limited, Clarence Street, Hanley, Stoke-on-Trent.—Capital £2,000 in £1 shares. Directors: J. F. Cross (managing director) and A. J. Miller (chairman). Engineers.

A. & M. Hamilton, Limited.—Capital £1,000 in £1 shares. Solicitors: De Meza and Menasse, Bank Chambers, 24, Bishopsgate, London, E.C.2. Electricians, mechanical engineers, etc.

J. G. Vernon & Company, Limited, 19, Bowling Green Lane, London, E.C.—Capital £5,000 in £1 shares (1,000 "A" and 4,000 "B"). Engineers. Directors: A. E. Tilley and M. V. Ward.

Butterley Company, Limited.—Net profit, £239,390; brought forward, £79,550; total, £318,940; available, £258,940; final dividend, 4d., and bonus 1s. 2d. per share, both free of tax; reserve, £100,000; carried forward, £68,940.

Head, Wrightson & Company, Limited.—Balance of undivided profits from last year, £3,362; transferred from reserve account, £23,000; loss for year, £7,003; balance, £19,358; interest on debentures, £6,750; dividend on preference shares, £9,302; reserved for dividend on preference from March 31 to April 30, 1925, £845; carried forward, £1,460; no dividend on ordinary shares.

Sir William Arrol & Company, Limited.—Loss, after providing for all charges with exception of depreciation and after deducting £8,684 brought forward, of £138,387; including amount paid in preference dividend for year to September 30 last, debit balance, £160,048; transferred from special reserve fund, £20,770, and ordinary reserve fund, £50,000; adverse balance carried forward, £89,278.

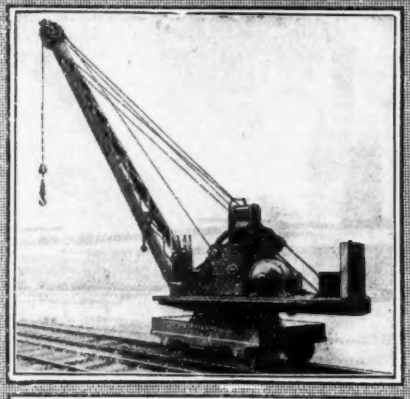
The Mint, Birmingham, Limited.—Depreciation, £4,146; profit, £19,888; brought forward, £10,860; disposable, £30,749; interim dividend on ordinary, 10 per cent. per annum, free of tax, and 12 months' dividend, less tax, on preference, £7,720; final ordinary dividend, 1s. per share, free of tax, £4,000, making 10 per cent. for year, and a bonus 2s. 6d. per share, free of tax, £10,000; carried forward, £9,029.

General Electric Company, Limited.—Net profits, £1,029,983; brought forward, £212,452; total, £1,242,435; debenture stock interest, £238,528; depreciation, £191,320; contribution to pension fund, £15,546; dividend, 6½ per cent. per annum on "A" preference for year, £117,000; dividend, 7½ per cent. per annum on "B" preference for year, £135,000; reserve account, £172,386; dividend, 7½ per cent. per annum on ordinary for year, £158,398; carried forward, £214,255.

JOHN M. HENDERSON & COMPANY, LIMITED, Kings Works, Aberdeen, have removed their London office to Amberley House, 12, Norfolk Street, Strand, W.C.2.

THE ANNUAL REPORT of the Anvil and Vice Trade Association states that the trade is faced almost with annihilation. Complaint is made against the Disposal Board for selling anvils and vices from war stock at a very low figure compared with the original price.

Smith's Reliable Cranes



Quick Delivery

Our Standard Steam and Electric Cranes are always in course of construction in our workshops, which enables us to deliver promptly They are the most economical and quickest working cranes on the market.

ESTABLISHED 1820.

THOMAS SMITH & SONS (RODLEY) LTD LEEDS

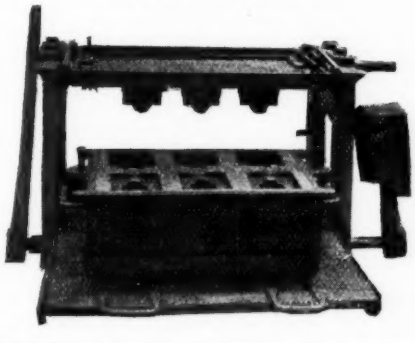
LONDON OFFICE—25 VICTORIA ST.

HESLOCK

HAND-RAM TURN-OVER

MOULDING MACHINE

Simple, Substantial, Accurate, Modest in Price.



STANDARD SIZE: Take Boxes up to 24"×18"×8"

Patentees and Makers:

JOHN BOOTH & SONS

General Ironfounders,

RIPPONDEN, nr. HALIFAX

Through a 120 Mesh Screen

77% OF THE DUST

and Grit caught by a

DAVIDSON

Patent

FLUE DUST COLLECTOR

installed in a London Power Station is so *fine* that it will pass through a 120 Mesh Screen

The "Davidson" Patent Flue Dust Collector removes not only cinders from the flue gases, but extracts the most minute particles of dust and grit. The Fan, which provides the Induced Draught, operates the Dust Collector, no other running auxiliary being necessary.

···TRADE··· SIROCCO ···MARK···

"DAVIDSON" FLUE DUST COLLECTORS

Have been installed in Shoreditch Power Station; Central Electric Power Station; Charing Cross Power Station; Marylebone Power Station; Treforest Power Station; Deptford Power Station; Grimsby Power Station; Barton Power Station, Manchester; Provan Chemical Works, Glasgow; and many others are in course of erection.

DAVIDSON & CO., LIMITED

Sirocco Engineering Works, Belfast

LONDON, MANCHESTER, BIRMINGHAM, GLASGOW, CARDIFF, BRISTOL AND NEWCASTLE-ON-TYNE.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The opening of the new quarter's trading has apparently brought little change for the better in the position of the Cleveland iron market, the outlook, both industrial and political, being hardly conducive to favourable developments in the direction of increased business, either for home consumers or on export account. Consequently buying is still mostly restricted to moderate tonnages to meet more immediate needs, consumers hesitating to undertake forward commitments until the outlook becomes less obscure and confidence is again restored. Ironmasters are therefore fully justified in their policy of reducing outputs in order to avoid over-stocking, with the result that there are now only fourteen furnaces producing Cleveland iron in operation. On the other hand, prices are again a shade weaker, this week's quotations ruling at 72s. per ton for G.M.B. No. 3 quality, with No 1 at 76s. per ton, No. 4 foundry 71s., and No. 4 forge 70s. 6d. per ton.

In the Tees-side hematite market business remains much as last reported, mixed numbers being offered at 77s per ton, with a premium of 6d. per ton for No. 1 quality. In the North-West area prices again indicate a downward tendency, with Bessemer mixed numbers quoted at £4 5s. c.i.f. Welsh ports, £4 8s. 6d. per ton delivered at Glasgow, £4 12s. 6d. per ton delivered at Sheffield, and £4 15s. per ton delivered at Birmingham.

The June shipments from the Tees show some improvement, totalling 75,440 tons in the aggregate, compared with 72,855 tons in May. Coastwise shipments of pig-iron fell from 16,270 tons to 12,482 tons, but thanks chiefly to the despatch of 4,600 tons to Denmark, the exports overseas advanced from 13,510 tons in May to 18,898 tons in June.

LANCASHIRE.—With the majority of foundries in this district experiencing a slack time, there is little business passing in the local iron markets, transactions being confined to almost retail proportions. At Manchester last week the nominal price for Derbyshire No. 3 foundry iron was round 78s. 6d. per ton, delivered, but it seems to be expected that before very long the furnace price will be down to even money, i.e., to 70s. at the furnace, equal to 77s. 6d. local delivery.

THE MIDLANDS.—At Birmingham recently a weaker tendency is noted in prices, and whilst the demand remains as meagre as it is at present, it is not easy to see how it will be possible to keep them from falling still lower. All the furnaces have good stocks, which, of course, they are anxious to liquidate, and it would not be surprising to find very shortly that Derbyshire No. 3 is available at under 70s. per ton. Ruling quotations for pig-iron are as follow:—Derbyshire No. 3 foundry, 70s. to 71s. 6d.; Staffordshire No. 3 foundry, 72s. 6d.; Northants No. 3 foundry, 66s. to 67s. 6d.

SCOTLAND.—Conditions in the foundry pig industry continue stagnant, with prices weak. Scotch No. 3 foundry is being offered at 82s. at the furnaces, but with the holidays so close at hand, practically no business is passing. No. 3 Middlesbrough is quoted at 76s. f.o.t. Grangemouth, and Continental iron at 69s. f.o.t. Grangemouth for No. 3 foundry, but with the continued depreciation in the franc, no doubt prices will go still lower.

Finished iron.

Continental competition in this class of material continues on an aggressive scale, and home manufacturers find considerable difficulty in finding sufficient orders to keep mills running even at partial capacity. This applies especially to makers of lower-grade bars for bolts and fencing, Belgian producers being able to cut rates to an extent rendering competition impossible. Manufacturers of marked bars are in a somewhat better position as far as demand is concerned, and are enabled to hold the price firm at £14 10s. per ton, while a rather more active inquiry is also reported for crown quality at £12 10s. per ton.

Steel.

Sheffield reports indicate that no improvement can be noted in the steel market, and in some quarters the view is taken that the depression will not lift this year. The buying of billets, both acid and basic, is dwindling, though the latter is in a worse case than the former. As an indication of the trend of things, some of the steelworks are suspending operations, and at Templeborough the great continuous wire-rod mill is idle. Crucible steel production is now very small, and the wire trade, which has had a good run of business, has fallen away sharply. The railway and motor steel branches are fairly busy, and in the light department tools and files are in good demand. Business in tinplates has again been distinctly on the quiet side, and the general tone of the market is anything but good. It is difficult to book any decent orders at over 19s. 6d. basis, and although some makers report having obtained 19s. 9d., it is said that 19s. 4½d. has been accepted in one or two instances.

Scrap.

The general conditions in the scrap metal trade continue extremely quiet all round, and without signs of an early improvement. In Lancashire the demand for foundry scrap is poor and intermittent, and for ordinary qualities from 72s. 6d. to 75s. is now quoted. For specially good lots perhaps a little more may be given, and for loom scrap there is a special price because of its scarcity. Very little breaking up of textile machinery is now going on, as the mills cannot afford new plant, and hence fine textile scrap will bring as much as 82s. 6d. In Scotland also heavy machinery cast-iron scrap is in slow demand, and very little tonnage is changing hands even at 80s. per ton. Ordinary cast-iron scrap is nominally around 72s. 6d. to 75s. per ton, with little business passing. Old cast-iron railway chairs have been disposed of recently at 79s. to 80s. per ton. Light cast-iron scrap and firebars can be had at 57s. 6d. to 58s. 6d. per ton. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—As is usually anticipated at the mid-summer period, business in the principal metal markets is below the normal average, and in the case of copper the tendency of values has been slightly irregular. Fair quantities of wire bars, however, have been taken by cable makers at around £63 5s., c.i.f., for future arrival, but values for electrolytic ingots and wire bars have eased again temporarily in the absence of any further important demand and owing to keen competition between dealers and American producers. Current quotations:—*Cash*: Thursday, £60 7s. 6d.; Friday, £60 10s.; Monday, £60 12s. 6d.; Tuesday, £60 15s.; Wednesday, £61 2s. 6d.

Three Months: Thursday, £61 7s. 6d.; Friday, £61 10s.; Monday, £61 12s. 6d.; Tuesday, £61 15s.; Wednesday, £62.

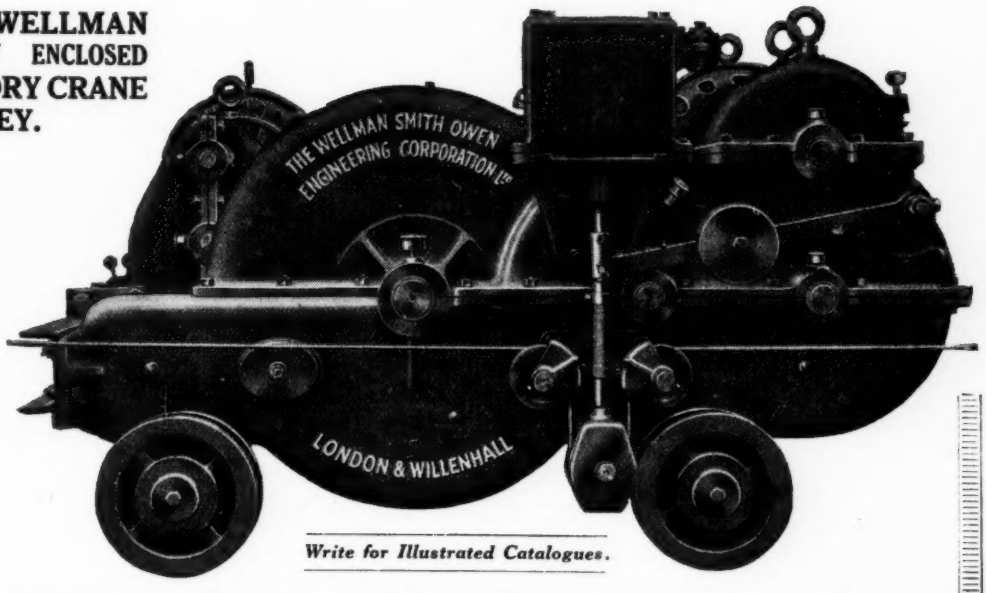
Tin.—Movements in tin during the past week have been on a somewhat restricted scale, pending the issue of the monthly returns, although values have not been seriously disturbed, and the market generally may be reported steady. After the cessation of the heavy operations to cover short commitments at mid-month, a notable element of support was naturally eliminated, but there continues to be a moderately optimistic feeling as to tin possibilities in anticipation of renewed increased requirements towards the autumn, particularly in the United States, and this explains the fact that there is no eagerness to make forward offers in the open market. Current quotations:—*Cash*: Thursday, £252 15s.; Friday £253 12s. 6d.; Monday, £253 10s.; Tuesday, £254 12s. 6d.; Wednesday, £256.

Three Months: Thursday, £255; Friday, £255 17s. 6d.; Monday, £255 17s. 6d.; Tuesday, £257; Wednesday, £258 5s.

Spelter.—Very slight fluctuations in values have been recorded of late in the market for this metal, and the position is practically as previously reported. There has been no material change in the European production, although Belgian smelters are now handicapped by some difficulty in regard to their supply of ores, while it remains to be seen to what extent they will be able to make up for the falling-off in their receipts of Australian ore concentrates. Current quotations:—*Ordinary*: Thursday, £34 6s. 3d.; Friday, £34 5s.; Monday, £34 7s. 6d.; Tuesday, £34 7s. 6d.; Wednesday, £34 11s. 3d.

Lead.—Shipments of soft foreign pig arrivals last month were fully up to expectations, while recent advices about the Burma Corporation mines are also taken to be favourable to output. Of late, however, trade buying has been very prominent, and turnovers amounting to over 8,000 tons in a week must be considered good. Generally speaking, the statistical position of the metal is very healthy and the technical situation sound. Current quotations:—*Soft foreign (prompt)*: Thursday, £33 6s. 3d.; Friday, £33 17s. 6d.; Monday, £34 7s. 6d.; Tuesday, £34 7s. 6d.; Wednesday, £33 18s. 9d.

THE WELLMAN TOTALLY ENCLOSED FOUNDRY CRANE TROLLEY.



Write for Illustrated Catalogues.

ELECTRIC FOUNDRY CRANES

Our Standard Electric Overhead Travelling Cranes have been designed primarily to meet the requirements of Iron and Steel Foundries. All gears are totally enclosed, ensuring long life under arduous working conditions in the Foundry atmosphere full of dust and grit. All parts are interchangeable. Replacements from stock.

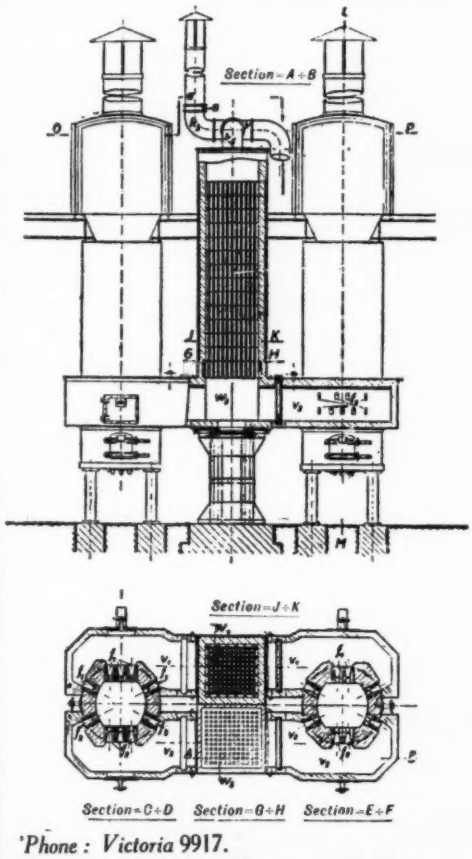
THE WELLMAN SMITH OWEN ENG. CORP. Ltd.

TELEPHONES: *Holborn 2588/9.*

36-38, Kingsway, LONDON, W.C.2.

WORKS :: :: DARLASTON, S. Staffs.

TELEGRAMS: *"Principium, Westcent, London."*



'Phone: Victoria 9917.
'Grams: "Smeetolim, Sowest, London."

SCHURMANN *(PATENT)* SIDE BLAST CUPOLA WITH REVERSING REGENERATORS

CONVERT YOUR CUPOLA TO THE SCHURMANN SYSTEM AND SAVE PRODUCTION COST BY LESS COKE CONSUMPTION, INCREASED HEAT OF METAL, LOWER SULPHUR CONTENT WHEN METAL RUNS INTO LADLE, AND SAVING IN INCREASED LIFE OF LINING DUE TO SHALLOW MELTING ZONE.

ADVICE GIVEN FREE

For information apply to:

THE

BRITISH SCHURMANN CUPOLA & FOUNDRY EQUIPMENT Co. Ltd.

15, VICTORIA ST., LONDON, S.W.1

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	61	2	6
Three months	62	0	0
Electrolytic	65	0	0
Tough	62	10	0
Best selected ..	62	15	0
Sheets	90	0	0
India	77	10	0
Wire bars ..	65	5	0
Do. July ..	64	12	6
Do. Aug. ..	64	12	6
Ingot bars ..	64	12	6
H.C. wire rods	68	10	0
Off. av. cash, June	59	19	2 5/7
Do., 3 mnths., June	60	18	9
Do. Sttlmnt, June	59	18	9 1/2
Do., Electro, June	63	11	5 1/2
Do., B.S., June	63	1	11 1/2
Aver. spot price copper, June	59	19	2 1/4
Do., wire bars, June	63	15	5 1/2
Solid drawn tubes			13d.
Brazed tubes ..			13d.
Wire			10d.

BRASS.

Solid drawn tubes	11 3/4d.
Brazed tubes ..	13 1/2d.
Rods, drawn ..	10 1/2d.
Rods, extd. or rlld.	7 1/2d.
Sheets to 10 w.g.	10 1/2d.
Wire	9 1/2d.
Rolled metal ..	9 1/2d.
Yellow metal rods	7 1/2d.
Do. 4 x 4 Squares	8 1/2d.
Do. 4 x 3 Sheets	9d.

TIN.

Standard cash	256	0	0
Three months ..	285	5	0
English ..	256	10	0
Bars	257	15	0
Straits	259	5	0
Australian .	258	5	0
Eastern ..	261	15	0
Banca	260	10	0
Off. aver. cash, June	252	11	8
Do., 3 mths., June	253	19	8 3/4
Do., Sttlmnt. June	252	12	7 3/7
Aver. spot., June	252	11	8

SPELTER.

Ordinary ..	34	11	3
Remelted ..	34	0	0
Hard	29	0	0
Electro 99.9 ..	39	5	0
English ..	35	0	0
India	30	10	0
Zinc dust ..	42	0	0
Zinc ashes ..	14	10	0
Off. aver., June	33	17	4 13/14
Aver., spot, June	34	2	11 3/4

LEAD.

Soft foreign ppt.	33	18	9
English ..	35	5	0
Off. average, June	33	4	6 11/14
Average spot, June	33	9	7

ZINC SHEETS, &c.

Zinc sheets, English	40	0	0
Do. V.M. ex whf.	40	0	0
Dutch			—
Rods	46	0	0
Boiler plates ..	40	0	0
Battery plates	39	0	0

ANTIMONY.

Special brands, Eng.	84	10	0
Chinese ..	64	10	0
Crude	51	0	0

QUICKSILVER.

Quicksilver ..	14	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon	
45/50%	13 0 0
75%	22 5 0
Ferro-vanadium—	
35/40% ..	16/3 lb. va
Ferro-molybdenum—	
70/75% c. free	7/- lb.
Ferro-titanium—	
23/25% carbonless	1/- lb
Ferro-phosphorus, 20/25%,	£22 0 0
Ferro-tungsten—	
80/85 %, c.fr. 1/5 to 1/5½	lb.
Tungsten metal powder—	
98/99%	1/9 lb.
Ferro-chrome—	
4/6% car. ..	£23 10 0
6/8% car. ..	£23 0 0
8/10% car. ..	£22 10 0
Ferro-chrome—	
Max. 2% car.	£42 10 0
Max. 1% car.	£52 0 0
Max. 0.70% car.	£56 10 0
70%, carbonless	1/5 lb.
Nickel—99%,	
cubes or pellets	£170 to £175
Cobalt metal—98/99%	10/-lb.
Aluminium 98/99%	£118
Metallic Chromium—	
96/98% ..	3/9 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 10 0
76/80%, packed	£16 10 0
76/80%, export	£15 0 0
Metallic manganese—	
94/96%, carbonless	2/-lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten ..	s. d. 2 6
Finished bars, 18% tungsten ..	3 0
Per lb. net, d/d buyers' works.	
Extras—	
Rounds and squares 3 in. and over ..	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do. under ½ in. × ¼ in.	1/-lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra

Scrap from high-speed tool steel—

Scrap pieces ..	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy, steel	3	5	0	to 3	7	6
Bundled steel &shrngs.	3	2	6	to 3	5	0
Mixed iron & steel ..		3	0	0		
Heavy cast iron	3	5	0	to 3	7	6
Good machinery for foundries ..		3	15	0		
Cleveland—						
Heavy steel ..		3	0	0		
Steel turnings ..		2	5	0		
Cast-iron borings		2	1	0		
Heavy forge ..		4	5	0		
Bushelled scrap		3	10	0		
Cast-iron scrap ..		3	15	0		
Lancashire—						
Cast-iron scrap ..		3	15	6		
Heavy wrought ..		3	15	0		
Steel turnings ..		2	5	0		

London — Merchants' buying prices delivered yard.

Copper (clean) ..	52	0	0
Brass (clean) ..	39	0	0
Lead (less usual draft)	30	0	0
Tea lead ..	26	0	0
Zinc	22	0	0
New aluminium cuttings ..	92	0	0
Brazierv copper	47	0	0
Gunmetal ..	47	0	0
Hollow pewter ..	163	0	0
Shaped black pewter	115	0	0

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1 ..	76/-
Foundry No. 3 ..	72/-
Foundry No. 4 ..	71/-
Forge No. 4 ..	70/6
Hematite No. 1 ..	77/6
Hematite M/Nos. ..	77/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	88/6
,, d/d Birm. ..	95/-
Midlands—	
Staffs. common* ..	102/-
,, No. 4 forge ..	70/-
,, No. 3 foundry	72/6
Shrops. basic ..	85/-
,, Cold blast, ord.*	190/-
,, ,, roll iron*	195/-
* d/d Birmingham.	
Northants forge ..	63/-
,, fdry No. 3 ..	66/9
Derbyshire forge ..	69/-
,, fdry No. 3 ..	70/9
,, basic	72/6
Scotland—	
Foundry No. 1 ..	87/-
,, No. 3 ..	82/-
Hem. M/Nos. ..	84/-
Sheffield (d/d district)—	
Derby forge ..	74/-
,, fdry. No. 3 ..	75/-
Lincs. forge ..	—
,, fdry. No 3 ..	78/-
E.C. hematite ..	87/-
W.C. hematite ..	92/6
Lincs. (at furnaces)—	
Forge No. 4 ..	—
Foundry No. 3 ..	72/-
Basic	72/-
Lancashire (d/d eq. Man.)—	
Derby forge ..	77/-
,, fdry. No. 3 ..	78/6
Northants foundry No. 3 ..	80/3 to 80/6
Dalzell, No. 3 ..	111/6
Summerlee, No. 3 ..	99/6
Glengarnock, No. 3	99/6
Gartsherrie, No. 3 ..	99/6
Monkland, No. 3 ..	99/6
Coltness, No. 3 ..	99/6
Shotts, No. 3 ..	99/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	11	12	6	to 12	10	0
Angles ..		12	7	6		
Tees to 3 united ins		13	2	6		
Nut and bolt		11	15	0		
Hoops	14	0	0	to 15	0	0
Marked bars (Staffs.) f.o.t.		14	10	0		
Gas strip ..		13	0	0		
Bolts and nuts, ¾ in. × 4 in. ..		16	15	0		
Steel—						
Ship plates	8	15	0	to 9	0	
Boiler plts.	£12	10	to	13	0	0
Chequer plts.	£10	10	to	11	0	0
Angles	£8	5	0	to 8	12	6
Tees	£9	5	0	to 9	12	6
Channels	£7	12	6	to 8	2	6
Joists	£8	5	0	to 8	12	6
Rounds and Squares 3in. to 5½in. ..		9	5	0		
Rounds under 3 in. to ¾ in.. ..		9	0	0		
Flats, over 5 in. wide and up ..		9	15	0		
Flats, 5in. to 1½in.		8	15	0		
Rails, heavy ..		8	10	0		
Fishplates ..		12	10	0		
Hoops (Staffs.)	£11	0	0	to 11	10	0
Black sheets, 24g.	11	15	0			
Galv. cor. sheets, 24g.	16	0	0	to 16	5	0
Galv. fencing wire 8g. plain ..		14	0	0		
Billets, soft	6	10	0	to 7	15	0
Billets, hard ..		9	0	0		
Sheet bars	6	12	6	to 6	15	0
Tin bars d/d	6	12	6	to 6	15	0

PHOSPHOR BRONZE

	Per lb.	basis.
Strip	1	2¾
Sheet to w.g. ..	1	3½
Wire	1	3¼
Rods	1	2⅜
Tubes	1	7
Castings	1	2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G. ..	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	20.26
No. 2 foundry, Birm.	19.00
Basic	19.76
Bessemer	20.76
Malleable	20.36
Grey forge	19.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess. billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	35.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.40
Sheets, black, No. 28 ..	3.10
Sheets, galv., No. 28 ..	4.15
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.60
Plain wire	2.45
Barbed wire, galv. ..	3.40
Tinplate, 100 lb. box ..	$5.50

COKE (at ovens).

Welsh foundry ..	37/6
,, furnace	27/6
Durham & North.	
,, foundry ..	35/-
,, furnace ..	17/-
Other Districts, foundry	35/-
,, ,, furnace (Basis)	13/6

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes, 20 × 14, box	19/6
,, 28 × 20, ,,	39/-
,, 20 × 10, ,,	28/3
,, 18¾ × 14, ,,	20/6
C.W. 20 × 14, ,,	18/-
,, 28 × 20, ,,	35/9
,, 20 × 10, ,,	25/-
,, 18¾ × 14, ,,	18/6

Terneplates 28 × 20, 1/3 per box basis below tinplates.

SWEDISH IRON.

Bars, hammered	£20/0 to £21/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£10 to £14
Pig-iron	£6 15 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES.

Up to and incl. 6 in.

Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
July 2	60	7	6	inc.	5/-
,, 3	60	10	0	,,	2/6
,, 6	60	12	6	,,	2/6
,, 7	60	15	0	,,	2/6
,, 8	61	2	6	,,	7/6

Electrolytic Copper.

	£	s.	d.		
July 2	64	0	0	inc.	5/-
,, 3	64	10	0	,,	10/-
,, 6	64	10	0	No change	
,, 7	64	15	0	inc.	5/-
,, 8	65	0	0	,,	5/-

Standard Tin (cash).

	£	s.	d.		
July 2	252	15	0	dec.	5/-
,, 3	253	12	6	inc.	17/6
,, 6	253	10	0	dec.	2/6
,, 7	254	12	6	inc.	22/6
,, 8	256	0	0	,,	27/6

Tin (English ingots).

	£	s.	d.		
July 2	253	0	0	dec.	5/-
,, 3	254	15	0	inc.	35/-
,, 6	254	10	0	dec.	5/-
,, 7	255	15	0	inc.	25/-
,, 8	256	10	0	,,	15/-

Zinc Sheets (English).

	£	s.	d.		
July 2	40	0	0	No change	
,, 3	40	0	0	,,	,,
,, 6	40	0	0	,,	,,
,, 7	40	0	0	,,	,,
,, 8	40	0	0	,,	,,

Spelter (ordinary).

	£	s.	d.		
July 2	34	6	3	inc.	1/3
,, 3	34	5	0	dec.	1/3
,, 6	34	7	6	inc.	2/6
,, 7	34	7	6	No change	
,, 8	34	11	3	inc.	3/9

Lead (English).

	£	s.	d.		
July 2	34	15	0	inc.	5/-
,, 3	35	0	0	,,	5/-
,, 6	35	5	0	,,	5/-
,, 7	35	5	0	No change	
,, 8	35	5	0	,,	,,

AVERAGE MONTHLY PRICE OF IRON HOOPS.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 5 0	6 10 0	6 3 4
1897	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0
1898	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	7 0 0	6 11 8
1899	7 0 0	7 0 0	7 0 0	7 0 0	7 12 6	10 12 6	8 12 6	8 12 6	8 12 6	9 2 6	9 7 6	9 17 6	8 2 6
1900	9 17 6	10 7 6	10 7 6	10 12 6	7 12 6	7 12 6	10 12 6	10 12 6	10 12 6	9 17 6	9 2 6	9 2 6	10 3 9
1901	9 2 6	8 2 6	8 2 6	7 12 6	7 12 6	7 12 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 11 8
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 6	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 7 6	7 0 0	7 7 6	7 1 8
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 10
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 6 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5½
1911	7 5 0	7 5 0	7 5 0	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 1½
1912	7 12 6	7 12 6	7 12 6	7 15 0	7 15 0	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	8 7 6	7 17 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1
1916	17 2 6	17 2 6	17 2 6	17 6 3	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1½
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 9 0	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1920	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	36 17 6	35 14 9
1921	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1922	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	13 4 6½
1923	14 0 0	15 0 0	15 0 0	15 0 0	15 6 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 16 0	14 15 0	14 18 3½
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½
1925	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SITUATIONS VACANT AND WANTED.

METALLURGIST wanted for Motor-car Works' Laboratory; sound knowledge of Heat Treatment and Metallography of Steel essential.—Applications, which will be treated with strict confidence, should state age, previous experience and salary required, to Box 376, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED, three or four good all-round Iron Moulders for Marine and General Jobbing Shop, Cardiff district; constant employment for suitable men. —Write, stating experience, with references, to Box 374, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MALLEABLE iron foundryman, with metallurgical experience, seeks post as Foreman or Superintendent; excellent record and references; modern methods in all departments.—Box 388, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ADVERTISER, holding Honours and Research degrees in Science, age 32, considerable technical and commercial experience, particularly in Non-Ferrous work, having been Works Manager and Research Metallurgist for several years, seeks position with progressive firm desiring to increase quality and quantity of output.—Apply, Box "C. Q.," Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PATTERN SHOP FOREMAN desires change. Best experience, machine, sand and loam moulding; young, energetic, good organiser, executive experience, disciplinarian. — Box 378, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

AGENCIES.

EXPORT TRADE.—Merchant firm desires to extend their export business, Continent and Colonies; general goods or specific bulk articles; would consider proposition from gentleman with knowledge and ability to organise connection; confidence respected.—Write Y. Z., Box 1120, SELLS, LIMITED, Fleet Street, E.C.4.

A WELL-KNOWN Foundry Equipment Company, manufacturing up-to-date foundry equipment and specialities for higher foundry efficiency, is desirous of appointing Agents, on a sole selling commission basis, in several districts throughout Great Britain; and also for each British Colony. — Applicants are invited to give full particulars as to experience, and ground covered, etc., Box 380, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY.

WANTED, Ladle, for 15-20 tons molten metal; side tipper on bogie; price and full particulars.—Box 382, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY, PLANT, &c.

POWERFUL HORIZONTAL DOUBLE-GEARED STEAM WINCH, by Clarke, Chapman & Company; 4 cyls., 11 in. diam., by 12 in. stroke; diam. of drum 2 ft. 6in. x 3 ft. face.

Two HORIZONTAL DOUBLE GEARED STEAM WINCHES, by Clarke, Chapman & Company; 7 in. cyls., 12 in. stroke, drum 24 in. x 33 in. face.

Seven nearly new HOISTING AND TRAVERSING PETROL WINCHES, by Hy. Bergerat & Company, for loads up to 10 cwt.; two independent barrels.

POWERFUL MOTOR-DRIVEN WINCH, by Clarke, Chapman & Company; drum 3 ft. 6 in. diam., 3 ft. face; driven by motor, 450 amps., 100 volts, 520 revs.

Nearly new STEEL LANCASHIRE BOILER, 30 ft. x 9 ft., reinsurable at 100 lbs. working steam pressure; complete with steam and furnace fittings, etc.

Two LANCASHIRE BOILERS, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. pressure.

Two CORNISH BOILERS, 28 ft. x 6 ft. diam.; reinsure 90 lbs. pressure.

Nine nearly new LOCO. TYPE BOILERS, 10 N.H.P.; reinsure 150 lbs. pressure.

VERTICAL COCHRAN LAND TYPE BOILER, 15 ft. high x 7 ft. diam.; working pressure 70 lbs. per sq. in.

CATALOGUE OF STOCK MACHINERY, 6,000 Lots. Free on Application. Inspection Invited.

THOS W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

MACHINERY.—*Continued.*

FOR SALE.—No. 2 Thwaites Cupola, with receiver and drop bottom, including Siemens motor and Roots blower.—Apply, ALFRED ELLISON, Black Lake Iron Works, West Bromwich.

FOUNDRY PLANT FOR SALE.

Two new "Morgan" 800 lbs. CRUCIBLE TILTING FURNACES; oil fired; could be converted to coke. Price £25 each.

HYDRAULIC BRIQUETTING PRESS, for copper and brass turnings. £75.

For further particulars and delivered prices write Box 386, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

SAND MIXERS.—New and secondhand. Ask us to quote.—W. BREALEY & COMPANY, LTD., Russell Street, Sheffield.

OVERHEAD TRAVELLING CRANES.

One 3-ton, 41 ft. 5¼ in. span, 3 motors, fish-bellied type girders, by Broadbent; new 1920; span easily shortened. Price £315.

One 2-ton, 35 ft. 9 in. span, with 1-ton auxiliary hoist, 4 motors, ordinary girder type, by Morris; span easily shortened. Price £150.

One 3-ton, hand power, OVERHEAD TRAVELLING CRANE, 41 ft. 5¼ in. span, by Morris; operated from ground. £45.

For further particulars and delivered prices write Box 384, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

SALES BY TENDER.

ROBERTS & COOPER, LTD.
(In Voluntary Liquidation),
GREAT BRIDGE IRON WORKS, TIPTON.

The Liquidator offers for Sale by Tender either

LOT A.—The FREEHOLD LAND at Great Bridge, comprising the above-mentioned Great Bridge Iron Works and all Buildings, Mills, Machinery and Erections thereon, and all the Tools, Plant, Utensils, Office Furniture and loose Chattels therein and thereon, or

LOT B.—The WORKING PLANT, MACHINERY, TOOLS and Loose EFFECTS on and about the said Works.

PLANT AND MACHINERY INCLUDE :—

(1) Puddling Forge, with 20 Furnaces, two Steam Hammers, 11 Boilers and Steam Ranges, and Boiler Feed Pumps, powerful Steam Engine, together with two Rolling Trains and necessary equipment to produce Bars from 2 in. to 15 in. wide.

(2) 16-in. Bar and Strip Mill, with two Furnaces; one Lancashire Boiler and Steam Range and Feed Pump; powerful Engine and Mill Equipment to produce Strip and Bars from 2 in. to 15 in. wide.

(3) 10-in. Merchant and Guide Mill, with two Furnaces; Lancashire Boiler, Steam Range and Steam Pump, powerful Engine with Condenser attached; Mill Equipment to produce Bars and Sections.

(4) Self-contained Condenser Plant and Engine.

(5) Electric Lighting Plant.

(6) Roll Turner Lathes, Tools and Engine, Plant, etc.

Forms of Tender and Conditions can be obtained on application to the Liquidator, T. H. GOUGH, ESQ., Chartered Accountant, of 267, Castle Street, Dudley; MESSRS. GOUGH, SON & CLARE, Chartered Accountants, 44, High Street, Brierley Hill; or MESSRS. SLATER & CAMM, Solicitors, 198, Wolverhampton Street, Dudley.

JOLT RAMMING MACHINES.

One No. 0 BRITANNIA with pattern draw - **£18**
Two No. 1 BRITANNIA with pattern draw, **ea. £32**
Four TABOR plain shockless 4" jolters, **ea. £16**
One EVANS shockless 32"×24" *turnover* jolter with 12" pattern draw, fine machine - - **£90**
One TABOR (14" cyl.) shockless 48"×32" *turnover* jolter with 26" pattern draw - - **£180**
Two MACDONALD (7" cyl.) turnover jolters to take boxes 40"×24" Ajax type - - **ea. £120**

All above Machines are in GOOD condition.

BUY FROM ME & ***SAVE MONEY.***

ALEX. HAMMOND,
FOUNDRY MACHINERY MERCHANT,
"BOXTED," SLOUGH.

'Phone: 287 Slough.